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Vol. 147 SATURDAY, MARCH 22, 1941 No. 3725

FOOD DISTRIBUTION IN WAR-TIME

THE food policy of the Government during the present War has followed three main lines : it has provided for the accumulation of stocks of certain essential commodities against siege conditions ; it has largely prevented profiteering and has achieved a reasonably equitable distribution of food by a system of rationing, by price control and by subsidizing the consumption of certain foodstuffs ; it has also, by special subsidies, as in the case of milk, and by a system of differential prices in the case of margarine, done much to ensure the adequate nutrition of the poorer groups of consumers. It is indeed probable that during the first year of war, with the increase in employment and earnings, and with little diminution in the supply of food, the general average of nutrition was as high, if not higher, than in peace. Recently, however, the position has altered, and it is doubtful if the policy which was successful in 1940 will be adequate for 1941.

The increase in sinkings which occurred in the last quarter of 1940, and the additional calls on shipping resulting from the African campaign, has entailed a revision of the food import programme. "Beef or Bardia" still holds. In consequence, we cannot expect in 1941 to live as comfortably or to eat the same kind of food as we ate in 1940 or before the War. It will be necessary to change our dietary habits, to depend less on meat and more on cereals, potatoes and the cheaper vegetable foods. But if available shipping is directed to the importation of essential foodstuffs, if each prospective cargo is considered in terms of the national health, we shall have enough to eat and remain a fit nation at the end of the War.

The matter, however, does not end with the question of maintaining supplies. The question of distribution is equally important. There must be no unfair distribution of food between income classes. As the food situation deteriorates, unrationed foods increase in importance. When scarce supplementary foods are neither controlled in price nor officially rationed, they will be mainly consumed by those who can afford to buy them. There will be no queues, but the lower income groups will go without. Poultry and canned fruit, for example, provide welcome additions to the diet of the well-to-do, but are little eaten by the poor. Restaurant meals are expensive and are mainly eaten by the rich.

In addition to the difficulty of distribution which inevitably arises in case of shortage, the 'blitz' has introduced problems of its own. When the bombing of London was at its height, too many young men and women, after spending an uncomfortable and exhausting night in a shelter remote from their homes, began their day's work on rolls and coffee because they could not afford a satisfactory breakfast. This condition, if allowed to persist, is likely to have a harmful effect on health and to hinder the national effort.

The problem of food distribution, therefore, resolves itself into ensuring that available supplies are spread over the population in accordance with needs, that the lower income groups get their fair share, and that adequate facilities are provided for feeding elements of the population whose nutrition is likely to suffer as a result of war conditions. Inequalities in distribution, which might be overlooked if other foods were plentiful, become important in a period of general scarcity, and the time appears to have arrived for a revision of the rationing system.

This revision might take one of several forms

It might be accomplished by introducing the point system, used in Germany, in which each person is given a weekly number of points which are evaluated in terms of different foods. Such a system has, however, the disadvantage that it is highly complicated in operation, and leaves the retailer too much discretion in deciding the food value of different qualities of the same commodity.

Alternatively, a limit could be placed on the weekly *per capita* expenditure on food. The objection to this method is that its adoption might result in the rich competing with the poor for the cheaper foods. This objection has been considered invalid on the ground that, if the rich did compete for the cheaper foods, the more expensive foods would fall in price and would be available to the poor. It is, however, doubtful if this would happen. In the case of certain foods it is more likely that they would go off the market. In the case of others it is likely that the present differential in price, which occurs between, say, high-price and low-price cuts of meat, would disappear, and that the poor would pay rather more for their meat and the rich less.

On balance, it appears probable that the extension of the present system of rationing to essential commodities in short supply is likely to prove more satisfactory than a system of general rationing. In cases where the amount of a commodity to be distributed is small and unlikely to provide an adequate national ration, the introduction of alternative rations might be considered. Eggs or cheese, for example, might be purchased on the same coupon. Also the rationing system should be as flexible as possible in order to admit full advantage being taken of foods which were temporarily plentiful.

It is, however, highly desirable that rationing should be supported by an extension of the present system of providing subsidies for special classes of consumers. The milk scheme which, at certain levels of income, enables free milk to be distributed to nursing and expectant mothers and to children under five, and which provides milk at a reduced price to the same classes, and to school children, whatever the income, is an important step in social progress. The classes to which it applies could, however, be widened in dealing with the distribution of certain foodstuffs.

During war the effect of rising prices is most severely felt by families with more than three children and by the small fixed-income groups, that is, by old-age pensioners, by pensioned widows and orphans, by the unemployed, by the families of men in the Services, and by persons in receipt of public assistance.

These, together with the present beneficiaries under the cheap milk scheme, and families with more than three children, form a substantial part of the population, and are likely to suffer hardship as a result of war. It is therefore suggested that certain foodstuffs in plentiful supply might be provided by subsidy to these classes.

In practice, the subsidy might operate by permitting the purchase of a daily *per capita* allowance of specific foodstuffs at a reduced price. It could apply in the first instance to such things as potatoes, which, compared with bread on a calorie basis, are expensive, to carrots and to green vegetables. It might also be applied to jam, which plays an important part in the dietary of the poor.

The adequate nutrition of the population in war-time, as well as the equitable distribution of food, would also be assisted by providing facilities for communal or collective feeding. Already a certain amount of work has been done in supplying meals in shelters, while the Ministry of Labour and National Service has been given powers to compel the owner of a factory engaged in Government contracts, and employing more than 250 workers, to provide a work's canteen. The efforts have, however, been largely unco-ordinated and spasmodic, and a more systematic approach to the problem is required.

Apart from the obvious economies which would be effected in the cost of materials, and in labour, equipment and fuel, the communal meal enables the right kind of food to be fed to different classes of workers. It makes possible the addition in concentrated form of essential food constituents not present in the original foods.

The provision of communal restaurants near large shelters would have a beneficial effect on the health of the shelter population, while the provision of works' canteens under proper supervision would do much to ensure the adequate nutrition of the factory worker, a problem which will increase in importance as more married women are employed in industry. In the same way, a midday meal in schools would help to safeguard the health of the future generation.

It is doubtful, however, whether any scheme will develop with sufficient speed unless it obtains the more active support of the Government. This support would be most adequately given in two directions: (1) by prescribing minimum

standards to be applied to collective feeding and by enforcing these standards by a competent inspectorate; (2) by training and registering staff for new canteens. The scheme might be operated partly by paid and partly by voluntary labour, and organized on a regional basis, linked up with the existing regional organizations. It would then, besides providing an immediate service, be available to undertake emergency feeding in any particular area.

PREHISTORIC COMMUNITIES OF THE BRITISH ISLES

Prehistoric Communities of the British Isles By Prof. V. Gordon Childe. Pp. xiv+274+16 plates. (London and Edinburgh: W. & R. Chambers, Ltd., 1940). 20*s*. net.

THE study of our prehistoric antiquities has already passed through several phases. The early antiquaries of Tudor and Stuart times are perhaps the most to be envied, for they could travel the country and indulge in picturesque speculation on what they saw, untrammelled by any established body of knowledge. The later eighteenth and nineteenth centuries witnessed the development of excavation, excavation which, while it began to accumulate the factual material necessary for later scientific study, was too often little more than looting to satisfy the collector's instinct and the land-owner's vanity and curiosity. By the beginning of the present century a rickety framework of information had been put together, and the achievement of outstanding individuals such as General Pitt-Rivers already gave promise of the extraordinary blossoming of a truly scientific archæology which took place in the period between two wars. The greater part of this happy period was naturally occupied with the essential preliminary task of extending conventional history backwards by establishing a fixed chronology, tracing invasions, the development of cultures and their interactions. But latterly a new trend was evident. Excavation had become sufficiently widespread, exact and selective to enable some archæologists to be less purely historical and more generally sociological in their approach. Attention began to be focused on the manner of prehistoric life, the structure of early societies, their economic basis and the density of their populations.

Prof. Childe looks through a historian's eyes, but he is far too sensitive to contemporary influence to ignore the new opportunities that were ready to his hand. Hence in this book he undertakes the difficult task of running the two methods, the historical and the sociological, in double harness. The plan of the whole book is historical: after a quick sketch of the first emergence of human societies in Palæolithic times, he follows their evolution in Britain down to the Roman period, with all the tale of invasions and cultural influences and the full archæological panoply of pot- and tool-typology. By dividing the space of time covered by the Neolithic, Bronze and Iron ages into nine parts, he even provides the first modern period-scheme for Great Britain comparable with the classic chronologies of Montelius, Muller and others on the Continent. Yet, throughout, social and economic changes are kept well to the fore, so that the book can with justice claim to be the first "to present a comprehensive account of the development of the societies inhabiting the British Isles in prehistoric times", and it is this aspect which is most stimulating and original.

The adoption of a "neolithic" economy, with agriculture and stock-breeding in place of hunting and food-gathering, must always cause an increase in population, and this fact, together with the soil exhaustion due to primitive agricultural methods, necessitates continual expansion on to new land. It was largely by this means that neolithic culture spread slowly westward from its eastern cradle until at last it reached our shores. Once arrived, this same economic urge dispersed it rapidly over the lighter soils of Britain, wherever simple hoe agriculture could be practised and flocks find open grazing. Prof. Childe makes the interesting point that one among the several distinguishable groups of neolithic settlers, the bearers of the Boyne culture, represent a rather different economy, the line of their settlement being dictated more by considerations of trade in gold and other metals than by those of husbandry. Although neolithic communities were very largely self-sufficing, there was one specialized industry of some importance—the mining of flint and extensive trading of axes made from it—which must have been in professional hands.

Side by side with the full neolithic societies there persisted a rather more primitive native culture which, although it had adopted certain neolithic traits such as potting, was still mainly dependent on the old food-gathering methods, and this element was to re-emerge in the Bronze Age, when for a time the relative importance of agriculture declined.

At the beginning of the Early Bronze Age the invasions of the Beaker Folk introduced a new ruling caste to dominate the old neolithic stocks. These newcomers, who seem to have been pastoral nomads, were able to extend over Britain "a degree of cultural uniformity . . . not repeated until Roman times". Although it would be folly to visualize a "Beaker state", their great holy centres of Stonehenge and Avebury, together with a widespread trade in luxury articles, show a considerable degree of co-operative purpose in both religious and commercial affairs. These Beaker pastoralists could spend the wealth they acquired as exploiting overlords on an improved material equipment; in particular, they provided important markets for the bronze and gold of Ireland, where a precocious knowledge of metallurgy and commerce was due to the tradition of the Boyne culture.

This same knowledge was inherited and developed in the Middle Bronze Age by the people of the so-called Food Vessel culture that grew up in Ireland and in Britain north of the Thames. Apart from their trade, the Food Vessel folk subsisted largely by pastoralism and hunting, and there is no doubt that they represent a reassertion of the old native tradition that we have seen persisting in Neolithic times.

In Wessex a wealthy aristocracy was in power in the Middle Bronze Age whose trade connexions were surprisingly far flung, extending to the Baltic, Central Europe and the Mediterranean. This Wessex society, with its hold upon the best land in the country, was so successful that numbers quickly increased under its rule, and the common folk, distinguished by their cinerary urns, expanded and spread far over England and Scotland and thence to Ireland.

Very important changes took place in the Late Bronze Age. In the first place, there grew up a caste of "international armament manufacturers" in bronze, perhaps detribalized, but wealthy and influential, who may have travelled the land in "veritable caravans", manufacturing and selling their wares. Prof. Childe is at his most interesting when he describes how this caste was ruined by the loss of markets after the introduction of iron.

Another still more significant change that took place later in this period was the introduction of plough tillage with settled fields and steadings, initiating the mixed farming that is still a force to-day.

Agriculture became increasingly intensive when the first iron-using immigrants arrived, and with this went a more developed social organization with nucleated villages as well as isolated farms. A new departure, prompted by the political and military conditions of the times, were the hill-top forts that might be either temporary refuges or tribal centres representing some degree of political unity among the farms and villages of their area.

With the coming of the La Tène Celts in the third–first centuries B.C., a fresh aristocratic class was instituted, particularly in the north of England, where a few ruling warrior families must have been the first patrons of the brilliant artists and skilled craftsmen who created the great British school of Celtic art.

Meanwhile, another group of La Tène Celts had established themselves in the south-west, originally to exploit Cornish tin, but soon spreading farther east and trading in lead, copper and iron as well as tin, and employing for the first time that most important social instrument, a standard currency.

So at last we reach the Belgic invasions of the first century B.C. that come already within the realm of written history. These part-Germanic part-Celtic people whose immigration into Britain is recorded by Cæsar, brought about far-reaching social change. They were ruled by princely dynasties, who established extensive kingdoms with capital cities that were political and commercial centres of importance. At the same time the Belgæ began at last the de-afforestation of the richer soils of England, and the tilling of the good land thus won with the heavy wheeled plough, so introducing the type of agriculture that was to be further advanced by the Anglo-Saxons and to last throughout our Middle Ages. This was the civilization which Claudius found established when he arrived with his elephants to conquer Britain for the Roman Empire.

In thus tracing social development in Britain from neolithic to Belgic times, Prof. Childe has accomplished something new and valuable. He has added solidity and human meaning to the old historical framework, while at the same time keeping the historical depth of perspective. If it is sometimes rather laborious to disentangle this social theme from the mass of archæological fact and description, that is because the author has too much respect for his reader to want him to accept his reconstructions without the evidence upon which they are based. Specialists will notice here and there inconsistencies and errors which can be attributed to the difficulties and haste imposed by war, but they do little to detract from the worth of the book as a whole. Indeed, after reading it, archæologists may well feel proud to recognize how far their work has gone towards recapturing the once-forgotten past of Britain so completely that the old distinction between pre-history and history is becoming more than ever meaningless.

J. J. HAWKES.

A SCHOOL CHEMISTRY

An Introduction to Chemistry

By A. C. Cavell. (1) Part 1 : Inorganic Chemistry. Pp. xiii + 512 + xiii. 6s. (2) Parts 2 and 3 : Physical and Organic Chemistry. Pp. xi + 513–712. 4s. (London : Macmillan and Co., Ltd., 1940.)

(1) A SPECIAL feature which is claimed for this book is the considerable care which has been taken to separate what the author considers to be necessary for School Certificate examinations and for examinations intermediate between this and Higher School Certificate, the latter material being given, along with historical notes, at the ends of the chapters. This separation does not seem altogether justified. The additional material on Avogadro's hypothesis (which is called Avogadro's law), for example (Chapter ix), would usually be found helpful by elementary students. The course provided, apart from the additions, gives the impression of a minimum one. Practical work and questions from various examinations are given ; in the questions the London General School Certificate examination is very sparsely represented.

The book opens with a historical introduction which is evidently based on good sources, except that Jabir and Geber are confused, as in other places (pp. 257, 310, 344, etc.). The definition of an 'element' on p. 10 is not very satisfactory, since the meaning of 'split', as applied to a substance, is not explained, and the definition of a 'pure substance', as given, would include solutions ; it would be more satisfactory to give the material on pp. 11–12 first. The atomic theory is briefly explained before the laws of combination, which is the historical order. It would have been possible, however, to re-word the definitions of atoms on p. 39 so as to take account of the existence of isotopes (which need not be mentioned) ; as it is, statement (ii), that "the atoms of a given element are identical", is not correct in the 'modern form' of the theory, which the summary claims to give. The author uses 'equivalent weight' for what is now usually called (following Faraday) the 'equivalent', and 'vapour density' is applied to permanent gases.

The theoretical sections are generally clear and adequate, and the order of the chapters is good. The non-metallic elements are dealt with first and the metals follow, after a chapter on electrochemical characters, which are made the basis of classification. This is satisfactory in an elementary course, although it places the metals in a very peculiar order from the point of view of the periodic law. Brief accounts of industrial processes are given. There is a chapter on volumetric analysis at the end, in which the definition of 'normal solution' given on p. 482 is incomplete, and does not agree with that on p. 491.

The style is generally good, but it is surprising to find on p. 482 the direction to 'tip' a solid into a vessel. Revision notes at the end of the book will be useful for reference. There are tables of logarithms and antilogarithms.

A few errors, some of which are common in textbooks, were noticed. It is scarcely correct to say (p. 144) that hydrogen is 'rather inert', since it combines directly with most of the non-metallic elements and with many metals, and reacts with a large number of compounds. The statement that argon was first called 'aeron' (p.118) is new to the reviewer, but may be correct. The eudiometer of Fig. 23 is Ure's, not Volta's, and on p. 160 the name is 'Warltire', not 'Waltire'. The product of oxidation of graphite is graphitic acid, not mellitic acid (p. 190) ; on p. 202 'linseed *oil*' is meant ; and on p. 210 Black's date is 1755, not 1775. On p. 222 the important fact that coal gas owes its poisonous nature to carbon monoxide (which is not stated on p. 227), should be mentioned. Carbon dioxide is usually said to liberate chlorine, not hypochlorous acid, from bleaching powder (p. 255), and since copper evolves hydrogen from hot concentrated hydrobromic and hydriodic acids, the basis of the argument on p. 305 is unsound. Bones are 'burnt', not 'distilled', to make bone-ash (p. 357) ; phosphorus was discovered by Brand, not Brandt, probably in 1674, not 1669, and it was made known by 'Krafft', not 'Kraaft' (p. 361). On p. 387 'Dobereiner' should be 'Döbereiner', and on p. 440 'Wohler' should be 'Wöhler'. The common error that the converter lining is used to dephosphorize the iron in the basic Bessemer process appears on p. 420 ; pure ferrous hydroxide is white, not green (p. 425), and ignited ferric oxide is insoluble in dilute acids (p. 426). Chrome alum does not usually crystallize after twenty-four hours from a solution which has been *boiled* (p. 478).

(2) Parts II and III are claimed to provide an elementary introduction to physical and organic chemistry sufficient for the first year of specialization after School Certificate, and are intended to bridge the 'wide gap' which the author finds between existing books of Certificate and Higher Certificate standards. Practical work is included. The section on physical chemistry (pp. 513–597) is largely concerned with molecular weight

determinations of gases and in solutions, with a short chapter on reaction velocity and equilibrium, and one on atomic structure, radioactivity and valency. The account of equivalent conductivity on pp. 551–52 is too brief to be of much value, and the definition of reaction velocity on p. 570 is incomplete, as it applies only to irreversible reactions. The course in physical chemistry is thus very elementary, but it will probably be adequate for the purpose the author has in mind.

The section on organic chemistry (pp. 598–701) is straightforward, and deals with typical classes of compounds. The old formulæ for glucose and fructose are given on p. 675, and the phenomenon of resonance in benzene is treated on pp. 678–688 as though it were a case of dynamic isomerism, which is misleading.

The book should fulfil the purpose for which it is intended, and it will assist teachers especially in providing some good laboratory work.

A WRITER TURNS FARMER

The Story of a Norfolk Farm

By Henry Williamson. Pp. 403+11 plates. (London: Faber and Faber, Ltd., 1941.) 10*s*. 6*d*. net.

READERS of Henry Williamson's books have long known that some four or five years ago he bought a derelict farm in Norfolk in a district thinly veiled under the pseudonym Whelk-on-Sea, and that he had settled down there with the view of putting it in good order and farming it properly. Few tasks could be more agreeable to a man of adventurous disposition: it involves serious difficulties, both material and human, and considerable financial risks, while failure, if it comes, is regarded as somewhat ignoble or at least in accordance with the forecast of local experts who "told you so". But success has a peculiar satisfaction, and for this men have been prepared to stake a good deal.

All this, and much more, is set out vividly by Mr. Williamson. From the outset he was under no illusions as to the magnitude of the task he had undertaken. In a preliminary look round he learned the local view of the farm; he was warned that this was no time to start farming, least of all for a beginner; he had no knowledge whatsoever of farming, and he took as his chief assistant a relative equally lacking knowledge and experience; and moreover he seems to have felt that he was regarded as lawful plunder by the supposedly simple country folk around. Right from the start he met with a full measure of troubles and difficulties. But he had several qualities to set against all this: a fixed resolve to carry the job through; the energy and enterprise to work himself and not simply to supervise others; he soon learned to manage his tractor, and he had a flair for hitting on the right course of action. Finally, he had the good sense to consult the county agricultural organizer, and fortunately for him Norfolk is particularly well served in this respect.

Of course, it all cost more than he expected, but reclaiming a derelict farm always does, just like restoring an old house. He had also some rather costly experiences with the old tenant and with an old cottager who refused to go. But he was fortunate in being able to continue his writing and broadcasting, and so kept the place going during the lean years.

Much of the book is autobiographical. "In telling the story of the farm," he writes, "I realized that it would be necessary to tell also part of the story of the farmer". These chapters will be particularly appreciated by those who already know and have enjoyed the author's earlier writings. Here he is engagingly candid: "With the exception of the salmon book, which was first class, the last three or four books I had published, while as good as most country stuff, were not much good, although in time students would find delight in finding out about the author, from the pages".

Later he tells of a "weekly nature article" written in an A B C tea shop, and if this is the usual practice of writers of "country stuff" it explains a good deal.

He gives sufficient technical detail for the agriculturist without tiring the general reader. He has much to say about the barley crop of 1938, one of the best in our time, on which, in common with many other farmers, he had counted hopefully; but unfortunately the price was nearly the worst in recent years so that he like many other farmers suffered severely through Nature's bounty.

In 1938 Mr. Williamson lost considerably. But in 1939 prices were better and his accounts balanced; from now on he should have some return until the next slump comes. The farm, however, was always much more to him than a mere money-making concern. He had the courage to refuse an offer of £600 a year for three years for the exploitation of a chalk pit, because this would have spoiled a beautiful part of England.

The book will be read with interest by all who think they would like a farmer's life, for it shows clearly some of the trials the beginner may encounter, and the satisfaction in overcoming them.

E. J. RUSSELL.

THE TORTUGAS LABORATORY

By PROF. K. M. YONGE,
University of Bristol

NEWS has recently been received that the Marine Biological Laboratory of the Carnegie Institution of Washington at the Tortugas Keys, Florida, has been closed owing to necessary restrictions of the Institution's programme in certain directions. The Laboratory buildings have been handed over to the United States Government, that portion of Loggerhead Key on which they stand having been originally leased from the Government for purposes of marine biological research.

The passing of this Laboratory, for thirty-six years one of the few centres of biological research in tropical waters, demands some words of farewell. Its origin is intimately connected with the history of zoology in the United States. Louis Agassiz visited the Tortugas Keys in 1851 in the course of his survey of the Florida reefs, and Alexander Agassiz spent some weeks upon them in 1881. His admirably illustrated report was published two years later in the *Memoirs of the American Academy of Arts and Science*. There is reproduced in "The Letters and Recollections of Alexander Agassiz" by G. R. Agassiz, a letter to Charles Darwin, headed Tortugas, April 16, 1881, in which Agassiz writes of his activities in mapping out the distribution of the corals.

Recollections of this visit must have been uppermost in his mind when Agassiz, in his capacity as a trustee of the recently founded Carnegie Institution of Washington, pressed for the addition of a Department of Marine Biology to its many activities. But he did more than suggest the site for the Laboratory: he provided, in the person of one of his former scientific assistants, Dr. A. G. Mayor, a director who was to control its activities with outstanding success from its inception in 1904 until his untimely death of 1922. It is impossible to think of the Tortugas Laboratory apart from Mayor. His greatest work was done at the Laboratory or on the numerous marine expeditions to the Bahamas and other islands of the West Indies, to Murray Island, Fiji and Samoa, financed by the Department of Marine Biology. His fundamental contributions to the study of Cœlenterates and Ctenophores were largely carried out at the Tortugas.

The wooden laboratory and living rooms were erected near the western extremity of the long sandy island of Loggerhead Key in the summer of 1904. A photograph reproduced in the third Year Book of the Carnegie Institution shows them as they were originally erected, on the bare sand fully exposed to the glaring sun. Visitors in later years were impressed with the wealth of vegetation which surrounded and shaded the buildings. But the coco-nut palms and ironwood trees were planted by Mayor to provide shade and some protection from hurricanes which may sweep with devastating force over this portion of the Gulf of Mexico during the autumn. With the passage of years additional buildings were added, while the capacious M.V. *Anton Dohrn* replaced the auxiliary ketch *Physalia*.

The reefs of the Tortugas form a rough circle, there being the usual sharp descent into deep water on the north-eastern, that is, weather, side. Here the force of the sea driven by the trade winds is too great to permit the formation of a sand key, but shingle ramparts of coral fragments have formed on the inner side of the reef, and in the shelter of these a few mangrove trees find precarious existence. Loggerhead Key lies on the south-west, in the lee of the reef complex, and its shores are buttressed by beach limestone. Other sand keys are scattered about, notably Long Key, which is relatively densely vegetated and provides a nesting place in the summer for hosts of sooty terns and noddies, as well as for the majestic frigate birds which batten on these smaller birds. The entire reef complex was, to me, vividly reminiscent of conditions on the reefs of the Great Barrier of Australia, which are moulded by the action of the south-east trades.

A unique feature is provided by the Marquesas Keys, which lie between the Tortugas and Key West and form an almost perfect ring. They contain no living coral but are formed of calcareous material of mixed origin thrown up above the surface and moulded by the action of the prevailing winds and currents.

The most remarkable feature of the Tortugas Keys is undoubtedly the immense brick erection of Fort Jefferson, which entirely covers one of the sand keys. Successive parties of visiting zoologists used to calculate the millions of bricks which had gone to its construction and the extent of the labour involved in their transport from Key West, seventy miles away. The military value of the Fort appeared problematical, but of its biological value there was, surprisingly, no question. On the piles of the wharf, in the deep shade cast by the crumbling planking overhead, grew corals

Fig. 1.

MEMORIAL TO DR. A. G. MAYOR AT LOGGERHEAD KEY, TORTUGAS. THE LABORATORY HUT IS SEEN BEHIND.

otherwise obtainable only in relatively deep water. Within the still waters of the wide moat there flourished, within easy access in all weathers, a representative collection of shallow-water corals and other organisms such as *Cassiopea xamachana*, on which much of Mayor's experimental work on Scyphozoa was conducted. During the great hurricane of 1919 the moat, which had stood undamaged for some seventy years, was breached on the north-western side, and further damage was suffered later. The result was to interrupt the previous flow of water through the moat so that those portions which remained filled constituted a sediment trap. A large-scale experiment in Nature was thus provided. A full list of the corals originally present had been provided by Vaughan in 1918 and they included all species typical of the inner reef flat. But when I examined the moat in 1934, apart from a few stunted specimens of other corals, the only common species was *Siderastrea radians*, which exhibited exceptional powers of modification, permitting life both in the surf region and also in still, sediment-laden waters.

It is natural first to consider corals in an account of the work of the Tortugas Laboratory. It was with these organisms and with the reefs which they form that Mayor and his principal associates, T. Wayland Vaughan, L. R. Cary and F. A. Potts among others, were primarily concerned. But the yearly visitors to the Laboratory covered a wide field in marine biology, as will quickly be revealed by reference to the contents of the well-known *Papers from the Tortugas Laboratory*, the thirty-second volume of which is now in course of publication. Mention of the work of W. R. Setchell on marine algæ, of A. L. Treadwell on annelids, of W. H. Longley on fishes, of D. H. Tennant and H. Lyman Clark on echinoderms and of P. Bartsch on molluscs, must suffice to indicate the range and value of this work.

After the death of Mayor in 1922 the Carnegie Institution did not appoint a new director, but Dr. W. H. Longley, of Goucher College, Baltimore, acted as executive officer in charge until his death in 1937, after which Dr. D. H. Tennant, of Bryn Mawr College, continued in the same capacity.

The Carnegie Institution has been most generous in its hospitality and many British workers have enjoyed the unique facilities of the Tortugas Laboratory. It was an exclusively male community, so that activities were never curtailed by any respect for the conventions of dress. One of the larger huts constituted a dormitory which contained a line of hammocks draped with mosquito netting. In the same hut were lodged the library and a laboratory, but a second, more recent, hut contained the principal laboratory and a working aquarium. Two motor-boats kept workers supplied with material, while the *Anton Dohrn* made occasional visits farther afield, as well as regular runs to Key West for stores and mail. The ingenuity and skill of Captain John Mills, engineer and seaman of unfailing energy and high spirits,

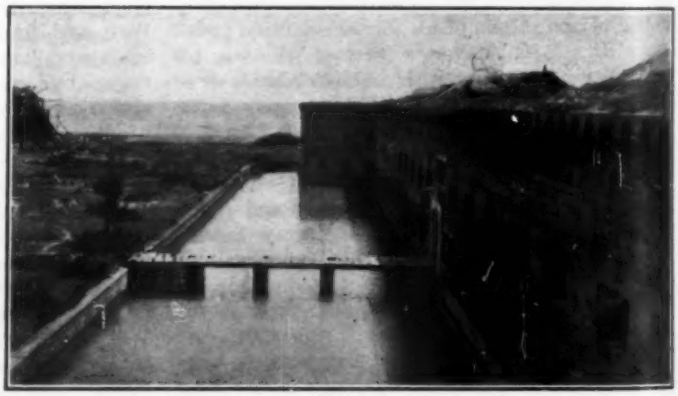

Fig. 2.

FORT JEFFERSON, TORTUGAS, SHOWING A PORTION OF THE MOAT AND THE BRIDGE LEADING TO THE MAIN ENTRANCE.

never failed to provide an answer to all problems of material and experimental equipment.

But for the War of 1914–18 it is possible that the Laboratory might, as Mayor wished, have been transferred to Montago Bay, Jamaica. Direct co-operation would thus have been possible between marine biologists from the United States and Great Britain. One can but hope that this aspect of the manifold activities of the Carnegie Institution of Washington may be resumed in due course, perhaps in collaboration with the Bermuda Biological Station.

CORROSION OF IRON AND STEEL IN SEA WATER*

THE eighteenth report of the Committee of the Institution of Civil Engineers on the Deterioration of Structures of Timber, Metal and Concrete exposed to the Action of Sea Water contains the final results of the fifteen years exposure of iron and steel specimens in the four harbours named, and also summarizes the results, previously published, of the five- and ten-year series. The observations on ferrous specimens are therefore now complete. Although the total number of bars exposed was large, only three of each material were exposed in each position, one of the three being removed at the end of each five-year period, so that there were no actual duplicates. It follows that accidental differences have a rather large effect, and it is only possible to make roughly quantitative comparisons, best expressed in graphical form. Naturally, wide differences were found between the results at different stations, partly on account of the prevailing temperature, but also owing to local circumstances. Thus, at Colombo the rise and fall of the tide is small, so that the half-tide specimens, being for most of their time in contact with water, were more nearly comparable with completely immersed specimens at other stations, and the bars exposed to the air were so often wetted by spray as to be comparable with half-tide specimens elsewhere.

All bars in this series of experiments were unpainted, but several materials were tested in two conditions: with adherent rolling scale and after removal of scale. The scale affords only temporary protection, and when flaking begins deep pits may be formed; so that although a scale-bearing bar may show a smaller loss of weight than its companion with the scale removed, it may actually be in a worse condition. Complications also arise from the accumulation of marine growths. In some instances this has led to a falling off of the rate of corrosion in the last five years of the test, the adherent growth being protective. On the other hand, considerable pitting may be found under the marine organisms.

Considering the materials in detail, cast iron behaved well in air, but when submerged was very liable to 'graphitization', the outer form being retained but the interior being converted into a spongy mass without strength. High-alloy steels of the austenitic type showed, as might be expected, a much higher resistance than carbon or low-alloy steels, but the cutlery type of stainless steel was less satisfactory when immersed in sea water. Such materials, from their high cost, can only be used in exceptional circumstances. Of the low alloy steels, those containing copper behaved well when exposed to air, but less well in sea water.

For practical purposes, mild steel and wrought iron are the most important ferrous materials, and it is this section of the report which will receive most attention. Using a system of averaging the results which was adopted after consideration, the numbers being too small for statistical treatment, it appears that under aerial conditions mild steel is less corroded than wrought iron of high quality; in fresh water there is little difference; and in sea water the wrought iron has the advantage. Some remarks on the effect of impurities in steel call for comment. The steel with high sulphur was also high in phosphorus, and the discussion seems to imply that the influence of these two elements would be in the same direction, which is unlikely. There were no specimens in which sulphur and phosphorus were varied independently.

On the whole, the results of these extensive field tests, carried out over a long period and with careful planning, are very much what might have been expected. The work of the Committee has, of course, covered much more ground than that of the present report, as it included both timber and concrete structures, as to the resistance of which to marine conditions there was much less information available. Of iron and steel it may be said that the inherent resistance of the ordinary varieties to marine corrosion does not vary very widely and that some form of protection is nearly always essential. Much more work on the nature of the corrosive process is needed, and is now actively in progress.

C. H. D.

* Deterioration of Structures of Timber, Metal and Concrete Exposed to the Action of Sea-Water. Eighteenth Report of the Committee of the Institution of Civil Engineers: Being a General Discussion of the Results of the Corrosion Tests carried out with Ferrous Specimens for 5, 10 and 15 Years at Auckland (New Zealand), Colombo (Ceylon), Halifax (Canada) and Plymouth (England). By Dr. J. Newton Friend. Edited by H. J. Grose. Pp. iv+52+9 plates. (London: Institution of Civil Engineers; William Clowes and Sons, Ltd., 1940.) 8s. 6d.

THE BANANA IN CENTRAL AMERICA

II. THE CONTROL OF CERCOSPORA LEAF DISEASE

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THE leaf spot disease of bananas caused by *Cercospora musæ*, Zimm., though widely distributed in the Indo-Malayan and Australian regions, was not recorded in the western tropics until 1934. During the brief period of two or three years from its first recognition in Trinidad[1], it had appeared with epidemic intensity in many of the Caribbean islands and on the mainland of Central and South America, and by its destructive effect on plantations showed itself to be a disease of first-class economic importance. In the Republic of Honduras, where successful control measures were eventually worked out, as described below, the disease was first definitely recognized towards the end of 1935, at which time the intensity of infections suggested a development period of perhaps twelve to eighteen months. The data available, unfortunately, throw little light on the question as to how this malady was introduced into the Caribbean or whether its spread took place from one or several centres of infection.

Briefly, the disease manifests itself as a profuse spotting of leaves; the tissue around the spots begins to die rapidly, and large, coalescing dead patches appear, so that in severe infections the leaf may be more or less completely destroyed. Bunches borne on affected plants show slow or arrested growth, behave abnormally during development and subsequent ripening, and commercially are valueless[2].

The success eventually achieved in Central America in controlling leaf disease is to be viewed in relation to previous work undertaken in Australia. The literature up to 1935 shows that no control measures had, in fact, been worked out[3]. In particular, dusting and spraying with fungicides had not met with the desired measure of success. Removal of infected leaves, fungicidal treatment of suckers, different spacings of plants and the growth of cover crops, all yielded results which were either negative or uneconomic.

When Cercospora leaf disease became established in the vast banana plantations in Central America, the economic losses, within a very short time, were formidable, and it was evident that some measure of control *must* be secured if a major agricultural disaster was to be avoided. Only those who have ridden for hours through miles of scorched, brown plantations, with extensive defoliation in progress, and everywhere small worthless bunches ripening on the plant, and who, by contrast, have seen the leafy greenery of a first-class plantation in full production, can appreciate the havoc wrought by this new malady as it waxed to epidemic proportions.

Here indeed was a challenge. The scientific staff of the principal fruit company spared neither labour nor expense in an effort to determine whether or not thorough dusting or spraying, repeated as each new leaf appeared, would give protection against the disease. For it should be noted that a monocotyledonous plant such as the banana, which produces its complement of some twelve to fifteen large leaves one by one at intervals of two to three weeks, according to growth conditions, presents a problem of unusual difficulty when it is a question of securing adequate spray coverage on a majority of the leaves. The work of Stahel[4] on *Cercospora musæ* as it affects the Congo banana in Surinam had shown that only the young leaves in the centre of the foliage crown were susceptible, and hence, for thorough protection, each new leaf should be sprayed as it emerges from the top of the pseudostem and begins to unroll. Actually, more recent investigations have shown that the older leaves of the Gros Michel are also susceptible; but this only adds to an already exacting task and justifies the present procedure in Central America of spraying plants right through to the harvesting of the bunch. The problem confronting banana growers, then, was twofold, namely, the application of dust or spray fungicide over vast acreages, and the frequent treatment of plants of all ages throughout the year. Truly a formidable task and one, moreover, to which it seemed improbable that there could be an economic solution.

As the programme of experimental work was steadily pursued, the epidemic took an ever-increasing toll of plantations, and it was evident that the industry was faced with the most serious crisis of its history. Or, as one writer, with characteristic Latin-American emphasis, put it: "Leaf disease has made a dwarf of Panama disease". At

length it began to be apparent, though final confirmation was far from having been obtained, that by spraying plants in short cycles of two to three weeks, that is, as new leaves emerged, with Bordeaux Mixture and other copper-containing preparations, a considerable measure of protection against leaf spotting was achieved. At this point the whole situation had become so critical that it seemed desirable that action should be taken on the preliminary results obtained, and the courageous decision was reached to install stationary spraying apparatus on a gigantic scale, the equipment to include power-houses, large spray-mixing tanks, pumping units and the materials for an ample pipe-line system extending right through the plantations. It was eventually found that a block of seven to eight hundred acres made a satisfactory unit for a single spraying 'project', several such units being necessary on each large banana division. On the Ullua River (Republic of Honduras) there is to-day a continuous area of 36,000 acres (about 60 square miles) under permanent pipe-line spray control. Altogether, in Central America, more than 100,000 acres are now equipped with stationary installations. Once again, the industry is in a state of high productiveness, and notwithstanding the heavy expenditure on spraying equipment and on the machinery for overhead irrigation, good profits are being made. The control of leaf disease probably represents one of the greatest achievements in the history of phytopathology.

Fig. 4.

BANANA PLANTATION IMMEDIATELY AFTER DUSTING BY AEROPLANE.

Before proceeding to an account of the equipment and its manipulation, reference may be made to the subject of fungicides. Many have now been tried and in various degrees have been found to possess practical value. By all tests and criteria, however, experience in Central America has consistently pointed to Bordeaux Mixture as the most satisfactory fungicide for the control of leaf disease.

Reference may also be made to dusting by aeroplane. Briefly, spray has proved superior to dust: the latter is quite expensive and does not give the same certainty of control as spraying does. In practice, dusting by aeroplane is rather a tricky business, and, moreover, the period each day when applications can usefully be made is very brief; that is, in the early morning while dew still remains on the leaves. Dusting by aeroplane probably has its place, however, in those areas where the extent and duration of productiveness

Fig. 5.

PREPARATION OF BORDEAUX MIXTURE. THE TWO LARGE MIXING TANKS (EACH 2,000 GAL. CAPACITY) WITH THE LIME DEGRITTER ABOVE. IN THE BACKGROUND THE COPPER SULPHATE TANK CAN BE SEEN.

Fig. 6.

INSIDE THE MIXING SHED. THE OPERATOR IS STANDING ON THE PLATFORM ABOVE THE LARGE MIXING TANKS; RIGHT, THE LIME DEGRITTER; LEFT, THE COPPER SULPHATE SOAKING TANK.

do not warrant the installation of permanent, stationary equipment.

It should also be mentioned that the methods of cultivation used in plantations in Central America largely, if not entirely, preclude the operation of mobile spraying units, since the plantation floor is strewn with decaying stumps and logs, is rough and irregular in the absence of mechanical tillage, is overgrown with vines and shrubby vegetation, and is dissected by deep drainage ditches and in some instances by irrigation canals.

The spraying equipment, which now constitutes such a characteristic feature of banana plantations, has been derived, with modifications dictated by experience, from that used in United States orchards. Driving power for the pumps and mixing tanks is provided by a 40–50 h.p. Diesel engine. A spray pump, of the three-cylinder vertical type, with a capacity of 60 gall. min., at 600 lb. pressure and a speed of 120 r.p.m., has been found adequate for an 800-acre block operating on a 14-day spraying cycle. It may be noted that the high pressure under which the spraying fluid is maintained is of the greatest importance in providing a good coverage. Side by side with the power house is the mixing house where the spray is prepared. Bordeaux Mixture having come into general use as the most effective fungicide, the equipment of the mixing house has been specially designed to make its preparation as simple and efficient as possible. The two main mixing tanks, each of 2,000 gallons capacity, are provided with four propeller agitators with a central bearing. The warehouse floor, tank tops, and the floor of the railway car (in which materials are delivered) are all on the same level, thus facilitating the handling of materials and economizing labour. Situated above the two large tanks is a smaller tank described as a lime degritter (Fig. 5). Of approximately 300 gallons capacity, it is provided with an agitator which can easily be started and stopped. In this tank the proper quantity of lime is mixed with 250 gallons of water and vigorously agitated for as long as possible. Then, before use, during a period of five or more minutes, the grit is allowed to settle and the milk of lime drawn off through a 2-in. pipe which projects some three inches above the bottom of the tank. The copper sulphate solution is prepared in another tank which is divided into four compartments each of 200 gallons capacity (Fig. 6). Each compartment is fitted with a tray which holds the bluestone and

Fig. 7.

SPRAYING PLANTS OF MEDIUM STATURE.

descends some four inches into the water. For 2,000 gallons of spray of standard strength (that is, 5-5-50), 200 lb. of copper sulphate would be placed in one of the trays; at tropical temperatures this quantity will dissolve in about two hours. Mixing can be continued indefinitely by using the soaking tanks in rotation. The charge of copper sulphate solution is led into the large mixing tank through a 1·25-in. brass pipe, header and rubber hose. In Honduras, the method used in the preparation of Bordeaux Mixture is to add dilute copper sulphate solution to concentrated milk of lime. The latter is therefore run into the mixing tank, and the former, diluted to the required extent in a swirl box by the addition of water from a 3-in. hose, is added.

The pipe system used for the distribution of Bordeaux Mixture from pump house to plantation consists of 2-in. mains, 1·25-in. laterals, and 0·75-in. sub-laterals, all suitably galvanized. An economic and effective layout of pipes is designed separately for each project. As an indication of the scale of a typical unit it may be mentioned that main lines may extend to 10,000 ft., laterals to 4,000 ft., and sub-laterals to 800–1,000 ft. The spacing between sub-laterals may range from 160 ft. to 240 ft., this being determined by local factors such as the position of open drains and the

Fig. 8.

PART OF THE PIPE-LINE SYSTEM WITH STAND-PIPE.

Fig. 9.

REMOVAL OF SPRAY RESIDUE. THE NEARER BUNCH IS BEING DIPPED IN THE ACID BATH; THE FURTHER BUNCH IS BEING DRAINED BEFORE GOING INTO THE WATER BATHS.

conditions of the plantation floor. The actual installation of these extensive pipe-line systems has been accomplished by quite inexperienced labour, recruited locally. The pipes are simply laid on the ground. As to the very considerable detail relevant to mechanical aspects, blockages, deterioration, etc., it need only be said that each and all are the subject of careful study, and that a special repair and maintenance squad is constantly at work, supervising, testing and where necessary effecting desirable changes. The actual distribution of spray is by means of hoses; these are attached to the delivery pipes and dragged here and there over a limited area as required (Fig. 7). Eight to ten hoses may be in operation in one small area, and each spray gun may be opened and closed several times per minute. In these circumstances it is evident that very rapid changes in pressure may take place in the system: the undesirable effects which would normally result have, however, been satisfactorily overcome by the insertion at suitable intervals of vertical stand pipes (Fig. 8); these are 3 in. in diameter and 4 ft. high; the air cushions which they provide reduce water hammer and effect a balancing of pressure at the delivery nozzles.

Spraying operations are carried out by local labour. Members of the spray gang are always conspicuous by the whitish blue deposits of Bordeaux Mixture on their hats and shirts. They take a great pride in their work and describe themselves with all due solemnity as 'chemists'. The effective spraying of bananas is not an easy task: every stool includes plants of three ages (that is, the oldest plant bearing a more or less well-developed bunch, its immediate successor, also a tall plant, and a still younger follower); and there may be as many as 300–500 stools per acre. To lack of uniformity in the height of plants to be sprayed is added a further difficulty in that in plantations more than five or six years old the plants are very irregularly distributed. The leaf itself offers still further obstacles in that its waxy surfaces, vertically or steeply inclined when young, are not easily wetted. Nevertheless, all these difficulties have been overcome. Each stool is thoroughly sprayed from four positions, the jet being directed just below the top of the highest leaves (30–40 ft. above the ground), the lower leaves being adequately wetted by the downwardly drifting spray. Details of the construction of spray guns need not be entered on here; the essential point to be noted is that, at the high pressures used, the Bordeaux Mixture is applied as a veritable fog, the coverage afforded being surprisingly good and very effective. At the end of each day's work, the pipe-line system is washed out and left full of clean water.

The use of Bordeaux Mixture necessitates the removal of the spray residue from the fruit. This is effected by dipping freshly harvested bunches in a dilute acid bath followed by thorough washing in water—a procedure which removes the detritus accumulated during growth and therefore improves the appearance of the fruit (Figs. 9 and 10).

Installation, operation and maintenance have been the subject of careful costing. The control of leaf disease, involving as it does continuous spraying throughout the year at intervals of two to five weeks, is, of course, expensive. Nevertheless, experience has shown that the costs can be met and that considerable profits can be made. Most important of all, an epidemic disease which threatened a major industry with extinction has been conquered—an achievement which must be highly gratifying to those who have been associated with this notable phase of tropical agriculture.

Fig. 10.

SCENE AT FRUIT DEPOT. THE COUNTERPOISE APPARATUS FOR DIPPING BUNCHES IS SEEN IN OPERATION.

The control of leaf disease has many aspects. A few of these may be briefly noted here. While leaf disease can be controlled by the application of copper-containing sprays, knowledge of meteorological conditions, rate of development of leaves, and of the seasonal intensification of the disease is necessary in order that control measures may be undertaken at minimum cost. In fully grown plantations, the control of severe leaf disease is difficult and costly, and, as a rule, requires a considerable period of time to achieve. Experience has shown that the best procedure is to cut down all plants in affected areas and to secure control as the young plants come up. Considerable difficulty has been experienced in obtaining control in young plantations situated in close proximity to severely affected areas; instances are known where control could not be obtained until the adjacent diseased plantations had been cut down. Since adult leaves as well as young ones are susceptible, it is considered advisable to spray the entire stool thoroughly on each occasion, continuing through to the harvesting of the bunch. Good spray coverage means good control; the best coverage is obtained when properly prepared spraying liquid is applied under high pressure. In regions where growth is rapid, control is sometimes difficult to obtain; a close spraying cycle is then necessary, and should only be widened when sufficient knowledge of the local behaviour of the disease has been obtained. Spraying makes

for an increase in the bunch weight, but injury due to scale insects is intensified. Pruning of spotted leaves not only serves no useful purpose but even accentuates the effects of the disease. The fact that bad areas must in some instances be cut down before control in adjacent areas can be obtained is an indication of the important part played by the locally produced spore population.

Satisfactory as the position now is in respect of commercial control, it is generally admitted that costs are still too high, that many aspects of the disease, including the effect of soil and climate, are still imperfectly understood, and that research work on a comprehensive basis should be consistently pursued.

[1] Wardlaw, *Trop. Agric.*, **11**, 7, 173–175 (1934).
[2] Wardlaw, Leonard and Barnell, *Trop. Agric.*, **16**, 6 (1939).
[3] Wardlaw, "Diseases of the Banana" (Macmillan), Chap. xv. (1935).
[4] Stahel, *Trop. Agric.*, **14**, 9, 257–264 (1937).

OBITUARIES

Prof. Vito Volterra, For.Mem.R.S.

VITO VOLTERRA, who died on October 11, 1940, was the best known of the many fine mathematicians whom Italy has produced in our time. He knew everybody and went everywhere. He was a member of every academy from Leningrad to Washington. One found him lecturing now at the Sorbonne, now at Princeton, now at Prague and now at Madrid. He was a great personage in Rome for many years, professor at the University, member of the Senate, president of the Lincei; he had his hospitable flat in the Via in Lucina near the Piazza Colonna, and his Villina Volterra at Ariccia on the Appian Way. But like many another Italian scholar, he failed now and then to see eye to eye with his Government; his family were more incautious than he, and troubles came to them and to him; but he worked on to the end.

Volterra was born in or near Pisa, in 1860, and became a professor at an early age in that little Tuscan university; later on he went to Turin, and thence to Rome. His first papers were physico-mathematical, on statical electricity, elasticity, optics. But when he was twenty-seven he wrote a long paper on linear differential equations, following it up by a second part five years later; and these two papers were the foundation of his career. They lasted so well that he republished both of them in 1938, fifty years after they first appeared, the one with little change the other with none at all, as the first fifteen chapters of his last book in Emile Borel's series, on "Opérations infinitésimales linéaires". Volterra was soon famous for his skill in differential equations, and for the ingenious uses he put them to. By the time he was fifty, the Royal Society made him a foreign member, the French Institute did the same, and other honours fell thick upon him. In 1913 he wrote his "Leçons sur les équations intégrales et les équations intégro-différentielles", for his friend Emile Borel; he had spoken on the same theme to the Cambridge Mathematical Congress of the year before. Many similar books followed, some in Borel's series, some published elsewhere, and all are still in use. The last of them, published with M. B. Hostinsky's help less than three years ago, is the one which harks straight back to his youthful essay of 1887.

That differential equations have become vastly important to physical science is not all Volterra's doing, but he has done a lion's share. He used them in one of his early papers (in 1898) in the study of seiches, which Forel had been observing in the Lake of Geneva, which Chrystal was to study soon afterwards at Loch Earn, and which Proudman has since studied by methods similar to Volterra's. Even before this he had applied his equations to elastic torsion, magnetic hysteresis, and certain other phenomena which he liked to call "hereditary", because they involve the past history of the system. He lived to see his methods and his equations used in the most diverse fields, in connexion with matrices, in Smoluchowsky's study of the Brownian movement, in the theory of probabilities, even in economics and statistics.

Differential equations crop up of themselves in the study of natural selection. Volterra's daughter Luisa had married Dr. Umberto d'Ancona, then a young zoologist, now a leading authority on Mediterranean fish and fisheries; and Volterra was led to apply his mathematics to the struggle for existence among fish. The story begins with an imaginary sea inhabited by sharks and codfish, the devourers and the devoured: with the result (of which Herbert Spenser had caught more than a glimpse) that the two species increase and diminish by turns, in waves which never damp down to equilibrium. Volterra developed the subject in a great many papers. He brought it before the Oxford meeting of the British Association in 1926; he discussed it with the International Council for the Exploration of the Sea at Copenhagen in 1928; he gave lectures on it at the Institut Poincaré, and published them as "Leçons sur la théorie mathématique de la lutte pour la vie" in 1931. He revised and epitomized the whole matter at the Mathematical Congress in Paris in 1937; and here (if not before) he brought out the curious proposition—he called it a *paradoxe démographique*—Si l'on conserve sans altération les coefficients d'accroissements des espèces, une seule exceptée, la moyenne de la population de cette espèce ne changera pas, tandis que les moyennes des populations d'autres espèces changeront. An early abstract of this work of his had appeared in NATURE (I translated it for him) on October 16, 1926, p. 558.

Volterra went much farther in his later papers. He found in biological variation an analogue to Hamilton's principle in mechanics, with Maupertuis's principle of least action not far behind. He reduced the fluctuation equations to a Jacobian partial differential equation, and obtained the corresponding integrals. It is unlucky for us biologists that such paths go smoothly for a while, but then soar to heights unclimbable. Prof. Kostitzin's little book, "La biologie mathématique", for which Volterra wrote a preface, and which was reviewed at length in NATURE (of June 5, 1937, p. 943), is enough to show the range and the ultimate complexity of the biological problems. Volterra was not the first in this fertile field. He was forestalled, though he did not know it, by Ronald Ross's "Malaria Equations", by some of W. R. Thompson's studies of insect parasitism, and fully and precisely by A. J. Lotka in his "Physical Biology" (1925) and earlier papers. How much Volterra added of his own is not always easy to say, but he toiled over the subject, and enlarged and clarified it. D'ARCY W. THOMPSON.

VOLTERRA'S fundamental ideas have enriched many branches of mathematics. Most of these ideas can be traced back to his earliest papers, and originated in attempts to solve physical and mechanical problems. Though his books, and especially their titles, might suggest that he was primarily a pure mathematician, his thoughts never ceased to be active with problems of the actual world; he was not content with having devised elegant solutions of problems of applied mathematics, until the result had been tested by measurements on models or observations of the natural phenomena concerned. In his work on elasticity, for example, he made many clever experiments on rubber models, and his pupils or colleagues supplemented these experiments by others in which they used the double refraction method to measure internal strain. Again, in discussing heat flow in the earth, he applied his calculations to the St. Gothard tunnel, and pointed out the practical importance of the theory in tunnel boring. A paper he wrote on the Hall effect was followed by similar observations to test the influence of a magnetic field on the resistance of a metal plate.

Among his most important work was that on integral equations with variable limits, which originated in 1884 from a problem in electrostatics. He pointed out the analogy with limiting systems of algebraic equations, and in 1896 developed an elegant solution in terms of iterated kernels. Later he applied his methods to multiple integrals and partial differential equations.

So early as 1887 Volterra introduced the conceptions of 'functions of lines' (or rather curves) and functionals, and in later years developed a calculus of functionals that proved to be of great value in treating integro-differential equations, such as arose in his theory of 'hereditary' phenomena in physics and biology.

Volterra also showed how to apply Green's theorem in n dimensions to extend Riemann's method of characteristics so that it could be applied to solve boundary problems for linear hyperbolic partial differential equations in n independent variables. In particular, he discussed the cylindrical wave equation, and found the appropriate analogue of Kirchhoff's theorem on wave motion. The idea was also modified to suit systems of equations that occurred in his researches on wave motion in elastic media, and to parabolic equations. He constructed a theory of the differential and integral calculus of substitutions in connexion with the theory of ordinary linear differential equations, and showed that Fuchs's results could be interpreted as an extension of Cauchy's theory of residues. S. CHAPMAN.

Miss Bertha Porter

THE gifts of mind and character which, though they may fall short of brilliance, ensure that the holder, unless met by too adverse a fate, will presently find an opportunity for free development and fruitfulness, should be given high rank in a hierarchy of service. Amongst such souls Bertha Porter may be assigned a place.

Born at the end of the early Victorian period to the home of a successful architect in whose house in Russell Square many highly cultured men and women might be met, Bertha Porter early showed a keen interest in knowledge as such, and, after her short school-time at Bedford College was over, pursued this and that with diligence. This mental alertness, combined with methodical habits and self-discipline, soon made her serviceable, so that the student of psychical research was in her debt before she contributed to the building up of the "Dictionary of National Biography".

University College was so near Bertha Porter's home that the eager student was quick to catch the scent of a new trail there, and before long she was swept in, this time finally, to furnish the Egyptological *atelier* with a labour-saving appliance. Erman in Germany and Griffith in England, aware that for continuity of study the student of their day greatly needed a survey of past research, had perceived Miss Porter's qualifications for bibliographical work. A brief visit to the University of Göttingen had provided her at least with valuable contacts.

After five and twenty years of exact and patient research, Miss Porter had almost brought her labours to the point of publication when it became plain that further progress lay where she would no longer feel at ease. Other women were enlisted to aid her (1924), and gradually replaced her failing energy. But so solidly and accurately had the foundations been laid that the six volumes now published (out of eight or nine) are confessedly almost above criticism. "Porter and Moss" (or, to give the work its proper title, "Topographical Bibliography of Ancient Egyptian Hieroglyphic Texts, Reliefs, and Paintings") is now a household word in Egyptology.

Ten years in bed, after so many at the desk, were cheerfully met with the same patience and old-fashioned humour. Through life Miss Porter had kept to a quaint Victorian dress, as if in quiet assurance that that era needed no apology.

NEWS AND VIEWS

President Roosevelt and Aid to the Democracies

PRESIDENT'S ROOSEVELT'S speech at the dinner of the White House correspondents in Washington on March 15 will rank in future ages among the most momentous events in world history. Thereby he laid down a pledge that the efforts of a great and united people should suffer no relaxation until the total victory of the democracies over the menace of the aggression and tyranny of the dictators has been won. In his review of the events of the preceding week, following on the passing into law of the Lease-and-Lend Bill, or as he now preferred to call it the Aid-for-Democracies Bill, he stressed with the utmost emphasis two elements. Of these the first was that of speed. "The urgency," he said, "is now . . . the time element is of supreme importance," and he went on to recall, what was by that time well known to his audience, how the Bill was signed by him within half an hour of being agreed upon in both Houses of Congress, and that five minutes later he had approved a mass of articles for immediate shipment, of which, he added, many were already on their way. The second element upon which he dwelt with if anything even stronger emphasis was the comprehensive nature of the help for which democracies—among whom he went on explicitly to include China—may look to the United States, whence will come munitions in any and every form, planes, guns, tanks, ammunition, food, and the ships to carry them.

With a generosity without parallel in history, the total resources of the United States are placed at the service of those who are engaged in the struggle on behalf of free institutions; and the United States now is, in the fullest sense of the phrase, the arsenal of the democracies. Mr. Roosevelt called upon every grade of the people of the United States for great sacrifices in the interests of those in the fighting line; but he made this demand upon the national will to sacrifice and to work with confidence. For, as he had already pointed out, the decision had been fully argued by every means of popular debate, and the decisions of democracy when made were proclaimed not with the voice of any one man, but as the voice of one hundred and thirty millions. For every one of these millions the President said, the "ultimate stakes" are what he had already marked on a previous occasion as the four freedoms—freedom of speech and expression, freedom to worship God in his own way, freedom from wrong and freedom from fear.

This Presidential speech repays careful study. It is close packed with virile and telling phases, which owe nothing to rhetorical ornament. They have strengthened the enthusiasm of the people of the United States, and enheartened everywhere those who are engaged in the life and death struggle for the continued existence of democracy. Yet even the urgent and vital necessities of the immediate conflict must not be allowed to obscure the supreme significance of the President's pledge that "when the dictatorships disintegrate, . . . then our country must continue to play its great part in the period of world reconstruction for the good of humanity". Mr. Churchill, in acknowledging with gratitude in in the House of Commons the passage into law of the Aid-for-Democracies Bill, spoke of it as a Magna Charta for free nations.

It would indeed be rash to attempt to forecast even in part the implications of the close co-operation which this far-reaching measure will demand for its fullest implementation; but that Mr. Churchill's analogy is no rhetorical compliment, but rather an inspired vision of its potential force, is endorsed by Mr. Roosevelt's recital of the creed to which it will be his endeavour that reconstruction shall conform. Thus it runs: that any nationality, no matter how small, has the inherent right to its own nationhood, . . . that the men and women of such nations . . . can through the processes of peace serve themselves and serve the world by protecting the common man's security, can improve the standards of healthful living and provide markets for manufacture and agriculture. Through that trend of peaceful service every nation can increase its own happiness, banish the terrors of war and abandon man's inhumanity to man". Such then is the ultimate goal to which the President looks as the justification for his own resolve and that of the people of the United States to implement to the fullest extent the Aid-for-Democracies Bill, and for which he trusts it may be said in the days to come that "our children and our children's children will rise up and call us blessed".

Science and Post-War Reconstruction

PRESIDENT ROOSEVELT'S momentous pronouncement on "the great part" which the United States will play in post-war reconstruction will be received with heartfelt relief and gratitude by all who hold fast to faith in the future of democracy as an assurance of justice as between man and man and between nations in the new world order which is to come. Most of all, perhaps, is this clearly appreciated by men of science, to whom it is a fundamental conviction that the progress towards ideals of democracy —freedom of thought and action, justice and tolerance —is to be achieved only by the application of science and scientific modes of thought to the problems of securing the conditions in which alone free institutions can function freely.

This is not merely a matter of broad and far-reaching principles—principles framed, indeed, in the Christian spirit, but to which all, irrespective of creed, race or nation, will subscribe; but it involves as a practical measure the solution of a thousand and one subsidiary problems affecting the daily life of the

individual and the group or nation in which he has his being, and vitally affecting the performance of his function as a free member of a free society—problems of personal and social hygiene, education, food supply and an innumerable host of others upon which scientific workers have long been engaged and which still engage their thought even amid the preoccupations of war. In the field of the relations of national groups President Roosevelt's Aid-for-Democracies Bill has already paved the way for the lines of future inquiry and research. The vast range of inquiry into the conditions of ultimate security for humanity will draw upon the resources of all sciences, and not upon the biological and social sciences only.

New President of the American Association

DR. IRVING LANGMUIR, who has been elected president of the American Association for the Advancement of Science, is a well-known figure in international science, and has interested himself particularly in borderline fields extending between physics and chemistry. Early work by Langmuir on the adsorption and reactions of gases at solid surfaces proved to be of fundamental importance to an understanding of many of the phenomena of colloid chemistry, heterogeneous catalysis, surface tension, and even of such an apparently unrelated subject as thermionic emission. One everyday consequence of this work was the gas-filled electric lamp. Arising out of these investigations came the conception of the orientated monolayer as the state of material at phase boundaries, a view which has led to important advances of our knowledge of the mechanism of lubrication of metal surfaces, and of the structure of oil films on liquid surfaces. In 1938 he visited Great Britain as the first American to deliver the Pilgrim Trust Lecture before the Royal Society when he gave a characteristically informative and fascinating account of his views on the structure of protein films (see NATURE, December 17, 1938); and he also delivered the Faraday Lecture of the Chemical Society, when he dealt with monolayers on solids. Dr. Langmuir received the Nobel Prize for chemistry for 1932 and was elected a foreign member of the Royal Society in 1935.

Manchester Literary and Philosophical Society: Air Raid Damage

THE Manchester Literary and Philosophical Society lost its historic home, library and Dalton and Joule memorials in an air raid through the spread of a fire from warehouses. In the eighteenth century, when those who could not subscribe to the articles of the Anglican Church were excluded from the universities, academies were founded in several places, that at Manchester being a specially important one. Among the intellectual leaders of the time were Dr. Thomas Percival, a medical pioneer, and Joseph Priestley; and one of the teachers employed by the academy was John Dalton. A group meeting at Dr. Percival's house founded the Literary and Philosophical Society in 1781, and it met shortly afterwards for a time in the room attached to the non-subscribing chapel in Cross Street, which has also been burnt out. A little later the Society acquired the fine Georgian house which it has now lost, and, in that house, Dalton did his scientific work. A great deal of his apparatus and many of his notes had been placed in the basement to diminish risks, but the fury of the fire destroyed nearly everything. Dalton's watch, Joule's chronometer, some of Dalton's notes and a few small pieces of apparatus have been found and salved.

The Society has also lost, at least for a time, an income it has long received from a trust established on its behalf. In spite of these misfortunes of war, it is maintaining its activities and is asking the cultural societies of Manchester to take part in a co-operative effort for a common home worthy of the long tradition of scientific leadership associated with the names of Dalton, Joule and many later workers belonging to what is believed to be the next oldest learned society in England after the Royal Society.

The Science Museum: Air Raid Damage

THE Science Museum has suffered damage by bombs during air raids on London. A number of bombs have fallen in the vicinity of the Museum, and although the building has suffered from the loss of windows, little damage has resulted to the collections. In one attack practically all the windows on one side of the building were broken, as well as many of the roof lights. Fortunately, the damage sustained by the Museum collections is slight, although a number of exhibition cases in certain galleries have been damaged by blast. Although the Museum is closed to the public, the Science Library continues to remain open, and to afford the usual facilities to readers and borrowers.

The Respirator in an Emergency

THE Prime Minister and the Lord Privy Seal have both recently referred to the possible use of poison gas by the enemy. Although expressly forbidden at the Geneva Convention signed by all the powers, there are indications that make it highly desirable that the people at large shall take heed of the possibility, and review their individual and personal protection against this most horrible form of attack. Everybody has been provided by the State with an efficient gas mask or respirator; it is a simple matter to see that it is in good order and is instantly available at all times. It is not enough, however, to carry the respirator; the owner should practise frequently taking it out of the case and putting it on, holding his breath in the meantime so that the operation becomes a matter of routine which can be done in a few seconds. The respirator should be worn for periods up to twenty minutes, so that one's behaviour in it becomes perfectly normal and the original nervous feeling is forgotten.

Only after such practice does the respirator become part of oneself, and its wearing a matter of instinct in an emergency. If a person is so unfortunate as to be near a bomb containing a lethal non-persistent

gas when it falls, his death or survival is a question of how few seconds it takes to put on the mask. The cloud of gas is very deadly for some hundreds of yards down a street in the direction of the wind, the length of the most dangerous zone being greatest in narrow streets. Further, everyone should have a clearly thought-out plan in their minds what they are going to do should they encounter gas; this will have to be varied according to circumstances. For example, if they are splashed with a few drops of liquid blister gas the time available to prevent a bad burn is short—a matter of five minutes. A clear plan to enter the first house, drop clothing on the doorstep and wash vigorously with soap and warm water, will prevent them becoming a casualty.

The respirator as a filter of poisoned air depends on the outstanding property of suitably activated charcoal to absorb organic vapours: the charcoal is supplemented by a pad able to hold back the finest particles of dispersed substances. The respirator is the result of prolonged study by experts, aided by the leading men of science. It is an all-purposes defensive weapon as nearly perfect as anything which is mass-produced in such enormous numbers can be. It is carefully tested in the course of manufacture, and is considered to give full protection against any war gases in the concentrations in which they are likely to be encountered by a civilian. It is not exhausted by a single encounter with gas, but should continue effective for many months. It may well be that when a respirator is put on in gas, and however quickly, it will enclose a little of the gas, which will cause irritation during the first minute or so. The impulse to tear off the mask must be resisted; also the thought that the mask is not fitting or the filter is letting gas pass. Previous practice will have proved this thought to be wrong, and very soon the respirator will be comfortable. We can do nothing when a high explosive bomb falls near; we can save our homes if we are quick when incendiary bombs fall on them; we can defeat a gas attack if we have trained ourselves in doing it.

Preparation of Fine Chemicals

THE Advisory Research Council of the Chemical Society, in collaboration with the Association of British Chemical Manufacturers, is putting into operation a scheme for organizing the preparation of fine chemicals in Great Britain by part-time volunteer workers in the laboratories of universities, technical colleges, and other institutions. It is essential to the scheme that compounds so prepared must be required for work of national importance and be not available commercially, and that the manufacturers of fine chemicals are themselves unable, or do not find it convenient, to meet the demands. It is intended that preparations should be carried out on a cost-price basis which would include charges for materials, gas, electricity, etc., but not for the workers' services. No profits of any kind will be permitted. Those who wish their names to be added to the list of volunteer helpers in connexion with this scheme should communicate with the General Secretary, Chemical Society, Piccadilly, London, W.1, to whom inquiries for fine chemicals falling within the scope of the scheme may also be made.

Issues and Parties in India

AN English resident in the Punjab writes taking exception to views expressed in these columns in a reference to Mr. L. S. Amery's review of the political situation in India in August last (see NATURE, 146, 255; 1940). He points out that while it is true that there are differences among the Indians themselves, all parties are at one in desiring Home Rule. To attain Home Rule is, or is supposed to be, the purpose of the Indian National Congress; and the preponderancy of the Hindu community in it merely reflects the fact that Hindus are a large majority in the country. It is stated that Moslems are by no means all anti-Nationalist or anti-Congress, and in fact only one party of them is so—the Moslem League, a reactionary conservative body composed of big landlords, title-holders and the like. Indeed, he adds, if a straight vote could be taken without confusing the issue by an appeal to communal fanaticism through such cries as "religion in danger", it is very doubtful if the Moslem League would have a majority over the combined votes of progressive Moslem parties. It was in fact decisively defeated in the last elections in the four provinces which have Moslem majorities. As for the Princes, they are, he says, a relic of feudalism, and do not represent their people. Although Mr. Amery's last offer, having regard to the conditions, was not so bad, it encouraged minorities to believe that however fantastic their claims, the British Government would support them, or at least allow them to hold up Home Rule indefinitely, thus lending colour to the Indian view that Britain does not really mean to give up her power and is playing the game of "divide and rule".

While it is desirable to place on record such a view of the facts of the situation in India in the interest of clearer understanding, it by no means must be held to imply assent among a people with whom religious belief and ritual is all-powerful as in India. The admission that successful opposition to the National Moslem League would depend upon the absence of an appeal to communal fanaticism, demands disruption of the social and religious functions of the individual member of a community in everyday life which is opposed to the whole of Indian culture and tradition. No doubt in many of the more progressive among the people of India, this tradition has become weaker, but nevertheless even among them it persists in some degree. It is for this among other reasons that competent observers have doubted the wisdom or even the possibility of applying the democratic ideal to Indian conditions. On this account, and not with the view of delaying Home Rule by fomenting intercommunal differences, the British Government has sought to accustom Indian ways of thought to respect for the rights of the individual through a compromise which, for the time being, appears to lay undue stress upon the claims of minorities.

Humus and the Farmer

UNDER this title, Mr. G. V. Jacks, deputy-director of the Imperial Bureau of Soil Science, Rothamsted, delivered a lecture on February 12 to the Royal Society of Arts, in which he dealt with the origin of humus, its functions in the soil, and how far shortage of humus-producing organic manures can be made good by other means. Humus is derived from decaying plant and animal residues; it acts by promoting a granular structure in the soil, by supplying energy to micro-organisms, and by providing plant nutrients. In the natural state, vegetation supplies the kind of humus in which it best thrives, but cultivated crops do not supply such an optimum product, so that human intelligence and skill are needed to bring about that biological balance in the soil which is the essence of fertility. A grass cover is especially valuable for producing the granular soil structure that is needed by our basic crops, for these are also grasses, perennial for animal and annuals (cereals) for human consumption.

When a soil has lost its virginal fertility by long-continued arable husbandry, it is best rejuvenated by laying it down to grass for a shorter or longer period. When our ancestors first enclosed the open fields, they nearly always put them down to pasture. Later, when clovers and roots were introduced, mixed farming became possible, animals could be kept throughout the winter and their manure conserved for the land. To-day much stress is laid on the necessity for rejuvenating our cultivated soils by ley farming or alternate husbandry. But the use of grass and plant and animal residues does not suffice in the absence of human skill and intelligence. These attributes became manifest when drilling was first substituted for broadcasting seed, when the art of drainage was developed, and when artificial fertilizers were invented. Such fertilizers can provide all the nutrients plants require, though they cannot produce the granular soil structure effected by humus. Plant humus, on the other hand, will not make a soil fit for permanent agriculture, for a human society makes far greater demands on the soil than does any natural plant community; nevertheless, every scrap of waste organic matter which the land produces should be returned to it.

Soviet Agriculture

IT is stated by "Russia Today" Press Service that the average annual grain crop in the U.S.S.R. for 1937, 1938 and 1939, notwithstanding the severe droughts in the two latter years, amounted to more than 100 million tons, exceeding the 1913 harvest, the best in pre-revolutionary Russia, by one third. The grain crop of 1940 amounted approximately to 112½ million tons. There are 243,000 collective farms in the Soviet Union, embracing 18,800,000 peasant households, or 94 per cent of the total number of peasant households in the country. The Soviet Government has handed over to the collective farms for their free use in perpetuity 940 million acres of land, which represents an average of 50 acres per household. It is estimated that Soviet agriculture employs more than half a million tractors, nearly 170,000 harvester-combines and 200,000 lorries.

Swahili Plant Names

THE demand for Mr. Greenway's modest little "Dictionary of Swahili-Botanical-English Plant Names", having been greater than was expected, has caused the author to prepare a second edition which is nearly three times as thick (Pp. 308+10 plates. Dar es Salaam: Government Printer, 1940. 4s.). The format is the same, but there have now been added a separate list of botanical and common English names, a large number of Swahili names, and ten pages of diagrams to illustrate the short glossary of botanical terms. We have noted a few trifling misprints: 'Afromomum' for 'Aframomum', 'tripinnate' for 'bipinnate' (diagram), and 'capitula' for 'capitulum', the drawing for which might equally well serve as a model for an improved garden rake. The printing is excellent, and the author is to be congratulated on providing this enlarged edition of a very useful little book for those in East Africa with little knowledge of botany.

Seventh International Congress of Genetics

THE Proceedings of the Seventh International Congress of Genetics, which was being held in Edinburgh just prior to the outbreak of war, have been issued as a supplementary volume to the *Journal of Genetics*. The difficulties in holding the Congress and the magnificent manner in which the secretariat overcame many of them has already been commented upon in NATURE. The papers, covering a varied and wide field, are published either in entirety or in summary form, under an alphabetical arrangement of author's names. A subject index to these 331 papers increases the value of these Proceedings for those who desire to know recent thought and work in genetics. The production of such a publication, in present circumstances, deserves particular praise, since the authors of some of the papers had to leave the Congress in a hurry and are now out of reach.

Control of Soil-borne Tomato Diseases

PARTIAL sterilization of the soil by heat is one of the most potent methods of control of soil-borne diseases. Amateur growers, however, do not always possess the requisite apparatus, and various chemical treatments have been suggested. Formalin is the most readily available of these, but the liquid has certain disadvantages in practice. W. Brown has briefly reported (*Gard. Chron.*, February 8) good results with an American suggestion to use formalin adsorbed upon an inert carrier such as diatomaceous earth or sawdust. The experiments relate particularly to the damping-off disease of tomatoes caused by Phytophthora fungi, and in some cases a total control of the malady was effected by the use of formalin powder applied to the seed bed when the seed was sown. Such treatment appears to provide a sustained control of damping-off, and not merely to postpone it for a time.

University of London

THE period for which Mr. H. L. Eason was appointed as principal of the University of London terminates on September 30, and the Senate has decided that the post shall not for the present be re-filled. Mr. Eason has held the office of principal since July 1937, having been a member of the Senate from 1911 and vice-chancellor from 1935. The Senate, with the concurrence of the Court, has appointed Mr. Harold Claughton as acting principal as from October 1. Mr. Claughton has been clerk of the Court of the University since the institution of the Court in 1929, and has acted as deputy to the Principal since June 1940. From 1924 until 1929 he was financial officer and secretary to the Senate.

Under an emergency statute made by the Senate, no elections by Convocation of persons to be members of the Senate will be held in the year 1941, and those persons who are due to retire on the second Tuesday in May of this year will continue to be members of the Senate until the second Tuesday in May 1942. Under another emergency statute no elections to the offices of chairman of Convocation and deputy chairman of Convocation are to be conducted before March 1, 1942, and the present holders of these offices will continue in office until the tenth day of May 1942.

DR. J. H. Gray has been appointed, as from May 1, to the University chair of anatomy tenable at St. Mary's Hospital Medical School. Since 1937 he has been senior demonstrator in anatomy at University College.

The following titles have been conferred in respect of posts held at the College indicated: professor in dental surgery on Dr. E. C. Sprawson (London Hospital Medical College); reader in mathematics on Dr. Theodor Esterman (University College) and on Mr. A. C. Stevenson (University College).

The Worshipful Company of Clothworkers has established a fellowship for graduates in science in the University. The fellowship is to be known as the "William Gilles Fellowship in Science" and will be open to internal or external graduates of the University. The award will be made biennially and will be of the value of about £220.

The degree of D.Sc. has been conferred on: Mr. P. A. I. Gorer, of Guy's Hospital Medical School; Mr. D. W. W. Henderson, of the Lister Institute of Preventive Medicine; and Mr. R. W. Haines, of St. Thomas's Hospital Medical School.

University of St. Andrews

THE "University of St. Andrews: Handbook of the United College" published by the St. Andrews University Press is a neat little brochure clad in the scarlet of the well-known gown. The University stands first in Scotland in age, and the latest of its senior foundations, the College of St. Mary, is of 1537. That of 1450 is still represented by the tower of St. Salvator, conspicuous from the sea. The unique graduate rolls date from 1413. Quaint customs survive such as Kate Kennedy Day. There was a period of decay which Johnson saw; but the College revived to produce its full share of eminent men and a reputation for research in chemistry. The successful rigour of the past is shown by a student who entered in 1819 and lived for more than six months on little more than £14. Games were prohibited in the monastic College of St. Leonard except a weekly visit to the links in the company of a Master. "It takes a heid to play golf," as a famous exponent of it once remarked. Considerable use has been made of the book on "Historic St. Andrews and Its University" by Prof. J. Read, professor of chemistry there, while Mr. John Hinton Read has provided most of the photographs for the effective illustrations.

Announcements

PROF. J. B. CONANT, president of Harvard University, who is visiting Great Britain to discuss scientific collaboration with the United States, has had conferred on him the honorary degree of doctor of science of the University of Oxford.

PROF. EDWARD A. DOISY, professor of biochemistry in the School of Medicine of St. Louis University, has been awarded the Willard Gibbs Medal for 1941. This medal, one of the highest distinctions in chemical science, is given annually by the Chicago Section of the American Chemical Society. Dr. Doisy accomplished the isolation of vitamin K from dried alfalfa leaf meal and putrefied sardine meal in 1939. Before that he had, in 1929, isolated theelin, female sex hormone and, in 1936, dihydrotheelin, another sex hormone.

DR. DIRK BROUWER, associate professor of astronomy at Yale, has been promoted to a full professorship, and has been appointed director of the Yale University Observatory in succession to Dr. Frank Schlesinger, who retires in June next.

THE supply of radium amounting to 6 gm. of the Paris Curie Institute, which had been sent into the country before the entrance of the Germans, has now been returned to Paris.

AN Institute for Tropical and Subtropical Diseases has been opened at Modena under the direction of Prof. Giovanno Serra, formerly director of the hospitals at Albertville in the Belgian Congo.

THE National Book Council, 3 Henrietta Street, London, W.C.2, is sending out lists of books specially selected for use in factories and workshops. The first issue consists of two lists in a portfolio; these lists will be supplemented at regular intervals. The titles, publishers and prices of books are mentioned, and a brief note on each entry indicates its scope. The lists are being sent free of charge to some 5,000 engineering firms in Great Britain.

ERRATUM. The title of the book by Prof. M. G. Mellon reviewed in NATURE of March 15, p. 310, was incorrectly printed as "Chemical Productions"; the book, which is published by the McGraw-Hill Book Co., Inc., is entitled "Chemical Publications".

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

An Interesting Sidelight on the Causes of Coloration in Butterflies

IMMS[1] states that "pigment very commonly co-exists with structures that are, in themselves, colour producing" and that "combination colours are much more prevalent among insects than colours solely due to structural features . . . Iridescent colours are very often devoid of the presence of all pigment excepting black or dark brown . . . as a rule a background of this nature is necessary to the production of the brilliant and intense structural blues. . . ."

Butterflies of the Oriental genus Euploea well exemplify this phenomenon, often more strongly in the male sex, and a specimen of *E. tulliolus aristotelis* Moore from British North Borneo in the Oxford University Museum throws interesting light upon it.

The butterfly, a very fine fresh male, had been seized and released by a bird, and the nip of the beak has left a conspicuous ∧-shaped 'beak-mark' on the right fore wing extending from the hinder angle forward, near to the outer margin, to beyond vein 4; it is, of course, clearly shown on the under surface also. Such 'beak-marks' have long been a subject of special study at Oxford[2], where a large collection of specimens has been gathered together, but the interest of the one in question is that it illustrates Mason's remarks on these blue reflections[3]. He examined species of butterflies with blue-green bars, etc., and found that "the remainder of the surface is dull brown except in certain positions, when it is purple to blue-green, so that as the wing is inclined this colour flashes out. The scales in these brown to blue areas are not particularly convex [as they are in the blue-green areas] but are markedly inclined to the surface of the wing, so that the tip is higher than the base and the scale makes an angle of thirty degrees with the plane of the wing. The reflection from these scales is specular, and they therefore appear bright only when the angle of incidence of the illuminating beam and the angle of reflection along the line of vision are equal.

"The two factors render the reflection colour visible when one looks along the grain of the wing, but against the grain there is no reflection and the effect is that of the brown pigmentation. . . ."

I have not been able to find a reference to Euploea in this connexion, but the specimen under consideration shows the same phenomena; the whole wing is brown (or purple) except for small submarginal white spots. But the linear imprint of the bird's beak has acquired a colour different from that of the rest of the wing, being more blue than purple and not disappearing when the wing is tilted.

The microscope shows, first, that the pressure of the beak has ruptured the saccular scales so that the pigmented, brown, contents have escaped and dried in minutely granular masses. These, especially noticeable at the apex of the beak-mark, reflect strongly deep blue rather than purple.

Secondly, scales have been (*a*) displaced, (*b*) flattened along the line of the beak's contact, and being in different positions from the normal, tilted, scales, their striated surfaces reflect differently, so that the mark for this reason shows purple when the rest of the wing does not.

I am indebted to my friend Mr. E. B. Ford for help in the elucidation of this interesting result.

G. D. HALE CARPENTER.

Department of Entomology,
University Museum,
Oxford. Feb. 20.

[1] Imms, A. D., "Recent Advances in Entomology" (2nd ed.), p. 194 (London, 1937).
[2] Carpenter, G. D. Hale, "Further Evidence that Birds Do Attack and Eat Butterflies", *Proc. Zool. Soc. Lond.*, A, 223–247, Plates 1 and 2 (1937).
[3] Mason, C. W., *J. Phys. Chem.*, 30, 392-3 (1926).

Effect of Temperature on the Mutation Rate of an Unstable Gene in *Portulaca grandiflora*

THERE are few data on the relation between temperature and natural mutation rate, though obviously this is important in formulating any concept of the nature of genes. Delbrück *et al.*[1] have examined the consequences of regarding mutations as simple chemical changes in molecules, and have pointed out that if the 'life' of an allele be of the order of months or years, then the mutation rate may be expected to have a Q_{10} of the order of 5. Experiments by a number of workers (reviewed by Stubbe[2]) do in fact show a high Q_{10} of that order, for genes having 'normal' mutation rates (1 in 10,000 or more life-cycles) and particularly for the collective class of lethal mutations in the *X*-chromosome of *Drosophila melanogaster*.

A frequently mutating gene on the other hand, the miniature-3-gamma in *Drosophila virilis*, has been shown by Demerec[3] to be apparently but little affected by temperature differences, and Rhoades reported at the Seventh International Congress of Genetics[4] an apparent decrease in mutations of the gene *dt* (in conjunction with another factor) in *Zea Mays* with higher temperature. On the view proposed by Delbrück, even unstable genes like these should have a Q_{10} of not much less than 4, a value which it seems impossible to reconcile with Demerec's data, after making the fullest allowance for experimental inaccuracies.

We have carried out an experiment with a mutable gene which produces coloured spots on the petals and stems of *Portulaca grandiflora* (Ikeno[5]). Four clones were grown, and one representative of each was kept in a thermostatic chamber for six weeks.

The temperatures used were 25°, 30°, 35° and 40° C. The number of mutations was estimated by taking four shoots about 10 cm. long from each plant and observing the number of spots and their size. The results are given in Table 1, in the form of the number of mutations per cm. length of stem, of 2 mm. diameter. A correction was made for large spots, since in the coloured areas no more mutations occur. (One clone produced few mutations in the stem epidermis and is excluded from the table.) Altogether 630 mutations were counted.

Table 1.

Clone	25°	30°	35°	40°
1	2·89	2·05	1·07	0·54
2	2·92	2·39	1·09	0·60
3	2·75	2·22	0·86	—

There is a consistent, and statistically very significant, apparent reduction in mutation rate with increasing temperature.

It is of interest to consider mutation rate not as a function of time, as is done in Table 1, but of the number of cell divisions. The areas of epidermal cells were measured, and it was found that cell size increased with temperature throughout the range tested, though maximum stem elongation took place at 35°. In Table 2, values from Table 1 have been multiplied by corresponding cell areas; they are also adjusted by a common factor making the means of the two tables equal, for easier comparison.

Table 2.

Clone	25°	30°	35°	40°
1	1·70	1·98	1·25	0·96
2	2·42	2·14	1·28	0·71
3	3·45	2·59	0·90	—

These values are proportional to the mutation rate per cell; an analysis of variance of the data on which they are based shows that the effect of higher temperature in reducing mutation rate is still highly significant. Moreover, petals spots, including those from clone 4, though difficult to analyse quantitatively, show the same effect.

At this stage we can offer no explanation for this rather paradoxical result. It is very desirable to know how general it is among mutable genes.

As an example of the kind of complication which is met with in studying the effect of temperature, we wish to place on record that, in Portulaca, higher temperature produces less acid cell sap, as is the case with certain Crassulaceæ. It is conceivable that *p*H influences mutation rate, and temperature effect might thus be indirect; altered acidity is likely to be but one of many physiological conditions changed by temperature.

We hope it may be possible to describe these experiments fully later.

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[1] Timoféeff-Ressovsky, N. W., Zimmer, K. G., and Delbrück, M., *Nach. Wiss. Göttingen N.F.*, 1-13, 189 (1935).
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Determination of *p*H in Wood

In the course of certain researches in progress at this Laboratory it became necessary to find a satisfactory method of determining potentiometrically the *p*H of the moisture present in wood when the latter is in the air-dry condition, that is, at a moisture content of between approximately 5 and 20 per cent. Most *p*H determinations in the study of wood are applied to aqueous extracts prepared under standard conditions, and whilst the results so obtained are of value for some purposes, we have found that it is only when a wood exerts a relatively strong buffering action that an extract prepared, for example, by leaching 1 gm. of the powdered substance with 20 ml. of distilled water, can have a *p*H approaching closely in numerical value to that of the moisture of condition present in the wood substance prior to extraction.

Species	Moisture content at 60 per cent R.H. (% oven-dry weight)	*Mp*H
Mugongo *Ricinodendron rautenenii* Schinz.	8·14	6·69
Balsa *Ochroma* sp.	6·81	5·54
Beech *Fagus sylvatica* L.	8·93	5·21
Birch *Betula lutea* Michaux	9·65	4·62
Teak heartwood (*Tectona grandis* L.)	7·55	4·50
Oak sapwood *Quercus* sp.	11·11	4·40
Scots pine *Pinus sylvestris* L.	6·21	4·27
Sitka spruce *Picea sitchensis* Carr	10·25	3·98
Douglas fir *Pseudotsuga taxifolia* Brit. Sample (1)	8·70	3·67
Oak heartwood *Quercus* sp. Sample (1)	11·73	3·50
Oak heartwood *Quercus* sp. Sample (2)	10·86	3·16
Douglas fir *Pseudotsuga taxifolia* Brit. Sample (2)	9·77	2·89
Western red cedar *Thuja plicata* D. Don	8·27	2·46

It has been found by one of us (S. A. B.), however, that the *p*H of the water used to extract a sample of wood flour can be so adjusted beforehand that it undergoes no change when mixed in any proportions with the wood substance at room temperature. Thus, in short, the *p*H of the moisture of condition of the wood, which we propose to term the 'moisture *p*H', or simply '*Mp*H', is numerically equal to that of the solution containing free hydrogen ions which, when added to it under the conditions stated, undergoes neither a net loss nor gain of hydrogen ions. *Mp*H values, determined by means of the glass electrode, of samples of a number of wood species are given in the accompanying table.

It is hoped that full details about this new determination and some of its possible applications will be published elsewhere in the near future.

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True Surface Densities of Protein Films

IT has been disputed[1] whether Gorter's[2] method of spreading proteins to form surface films can really give a homogeneous film unless either (*a*) very dilute solutions are used for spreading, or (*b*) very long times, from 1 to 24 hours, are allowed before the force-area measurements are made. In the case of gliadin films, however, a vindication of the earlier method has been published[3] and it appears from the figures quoted here that equilibrium is achieved within a very few minutes after the film is spread.

Further measurements suggest, however, that although, as Jenkins and Taylor show, the surface-density figures for longer times are lower because of contamination of the surface, there is some merit in performing these measurements. The figures in the accompanying table which have been obtained for zein, show that the initial drop in surface density with time is much more rapid than the later fall, but not sufficiently rapid to avoid some contamination.

TABLE 1.

Time (mins.)	5	5	5	10	10	30	30	60	150	290	420	1400
$d \times 10^7$	1·32	1·40	1·35	1·31	1·33	1·26	1·32	1·19	1·16	1·10	1·07	0·89
Mean d		1·36			1·32		1·29					

It is clear that the surface density of the completely spread, but uncontaminated film, is obtained by extrapolating the shallow part of the curve to zero time, when a value of $1{\cdot}21 \times 10^{-7}$ is obtained for d. A somewhat similar curve is obtained, though with less regularity, for gliadin from the averaged figures of Jenkins and Taylor.

Measurements on hen's egg albumen show a similar trend. The spreading here seems to be considerably slower, and at least half an hour is required for complete spreading. The protein films are fully reversible and can be recompressed an indefinite number of times, without alteration in the shape of the compression curves. The figures for four different spreadings are :

TABLE 2.

Time (mins.)	10	15	45	60	80	90	180	Extrap. density
(1)		1·20		1·10		1·06		1·13
(2)	1·37		1·19			1·13	1·10	1·165
(3)	1·13		1·09			1·06		1·125
(4)	1·14		1·07		1·02			1·13

The extrapolated densities almost entirely smooth out the fairly wide variations between individual measurements at short spreading times, and the mean value of 1·14 is closely similar to results obtained in the same way for gliadin and zein.

All the measurements were made on a substrate of 0·01*N* sulphuric acid at room temperature.

There seems to be little doubt that this compromise between the methods of Mitchell and Jenkins and Taylor is the most satisfactory means of overcoming irregularities due to accidents of contamination and initially uneven spreading of the protein film.

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Diffuse Reflexion of X-Rays

PROF. G. E. M. JAUNCEY[1] derives the formula :

$$\varphi_{mB} - 2\theta_B = 2(i - i_B)\sin^2\theta_B. \qquad (1)$$

for the relative position of a Bragg reflexion and the so-called "modified reflexion". The symbols are defined as follows : i is the glancing angle of incidence on the crystal plane for which $\theta_B = i_B$ is the Bragg angle : φ_{mB} is the angle between the incident ray and the direction of scattering of the modified reflexion : $i - i_B$ is supposed to be small. The disposition of the incident ray I, the scattered ray S, and the crystal plane are shown in Fig. 1. Prof. Jauncey deduces (1) from a formula of Sir William Bragg's, and it is obtained from quite different assumptions by Raman and Nath and by Zachariasen. In fact (1) is only an approximation to a formula due to Faxén which may be put in the form :

$$d \sin \varphi = \lambda \cos(\varphi - i), \qquad (2)$$

where d is the spacing of the plane for which the Bragg angle is θ : $\varphi(=\varphi_{mB})$ and i are as shown in Fig. 1. Using Bragg's Law to eliminate d and λ from (2),

$$\sin\varphi = 2\cos(\varphi - i)\sin\theta. \qquad (3)$$

That (3) is an exact form of (1) may be proved by varying i and φ for constant θ, giving

$$\cos\varphi\,\delta\varphi = -2\sin\theta\sin(\varphi - i).(\delta\varphi - \delta i). \qquad (4)$$

When the angle of incidence changes from θ to i, $\delta i = i - \theta$, and at the same time the angle of scattering changes from 2θ to φ, so that $\delta\varphi = \varphi - 2\theta$: if i is nearly equal to θ, $\varphi = 2\theta$ and $\varphi - i = \theta$ approximately, so that (4) gives

$$\cos\varphi.(\varphi - 2\theta) = -2\sin^2\theta. \quad (\varphi - 2\theta - i + \theta)$$
$$\text{or } \varphi - 2\theta = 2(i - \theta)\sin^2\theta, \qquad (5)$$

which is identical with (1) when the suffixes are introduced.

The geometrical significance of Faxén's formula (2) is shown in Fig. 2. Here O is the origin of reciprocal space, B the Bragg spot, and P the modified reflexion. Faxén's formula states that P lies in the line joining B to C, the centre of the sphere of reflexion. The angles i and φ are shown on the diagram, CN being normal to OB. The formula follows at once from the geometry of the triangle OCB.

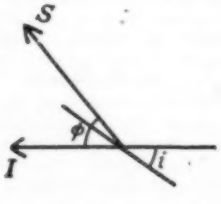

Fig. 1.

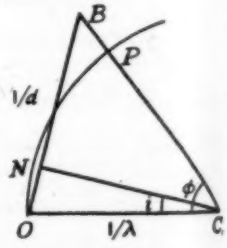

Fig. 2.

The physical interpretation of Faxén's formula is that the surfaces of constant intensity surrounding the Bragg points are spheres : I have found that the pattern given by aluminium[2] conforms to this rule, but at the time had not observed that this amounted

to a verification of Faxén's formula. The function used by Prof. Jauncey in arriving at (1) has the same property.

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[2] *Proc. Roy. Soc.*, A, **172**, 116 (1939).

Influence of Œstrogens and Androgens on Glycogen Storage in the Fasting Rat

Janes and Nelson[1] have observed that glycogen storage in rats treated daily with diethyl-stilbœstrol for five days or more is at an abnormally high level. We have investigated the influence of œstrogens and other sex hormones on glycogen storage; and also on the insulin content of the pancreas (*cf.* Griffiths and Young[2]). Data are given in Table 1, including the liver and muscle glycogen contents, after a fast of approximately 18 hr., of rats carrying subcutaneous tablets of various substances for two weeks. These results show that œstriol and œstradiol resemble diethyl-stilbœstrol in promoting glycogen storage under these conditions, although œstrone and testosterone do not. It appears that the influence of these substances on liver glycogen under such conditions is to some extent paralleled by their action in causing enlargement of the liver and an increase in pancreatic insulin; it seems possible that the latter phenomenon is secondary to the increase in glycogen storage.

When rats were fed on cellulose for 30 hours in order to deplete the glycogen stores, and were then given a single subcutaneous injection of various substances in nut-oil, an increase in liver glycogen was found to occur, in some instances, during a subsequent 30-hour fast. The results with different doses of diethyl-stilbœstrol in experiments of this type are shown in Table 2, and indicate that a single injection of 0·1 mgm. of this substance is capable of increasing the liver glycogen content of the fasting rat under such conditions. No obvious change in muscle glycogen content or in blood sugar level was observed in these experiments, with the possible exception of those in which 10 mgm. of diethyl-stilbœstrol was used. Again the increase in liver glycogen content was accompanied by an increase in liver size; it should be mentioned that the treated rats lost little, if any, more body-weight during the fasting period than did the control animals. Œstradiol and œstriol were found also to induce an increase in the liver glycogen content of the fasting rat under similar conditions, a property in which they resemble hormones of the adrenal cortex[3,4].

These experiments show that some œstrogens can exert a profound influence on carbohydrate metabolism, inducing an increase of pancreatic insulin and a positive increase, not merely diminished loss, of liver glycogen in the fasting rat, the latter being apparently not due to a transfer of glycogen from the muscles to the liver (Table 2).

TABLE 1.

INFLUENCE OF ŒSTROGENS AND OF TESTOSTERONE ON THE STORAGE OF GLYCOGEN AND OF INSULIN IN THE RAT.

Substance implanted	Number of rats in group	Blood sugar mgm./100 c.c.	Liver weight gm./100 gm. body weight	Liver glycogen gm./100 gm.	Muscle glycogen gm./100 gm.	Pancreatic insulin	
						u./100 gm. body weight	Percentage increment above control
Cholesterol (control)	30	108	3·82	1·13	0·37	0·70	—
Diethyl-stilbœstrol	30	109	5·79	2·27	0·41	0·95	36
Œstriol	10	115	5·13	2·32	0·39	0·93	33
Œstradiol	10	113	4·48	1·67	0·43	1·05	50
Œstrone	20	105	4·40	0·77	0·42	0·68	nil
Testosterone	10	99	3·68	0·69	0·44	0·68	nil

TABLE 2.

INFLUENCE OF DIETHYL-STILBŒSTROL ON GLYCOGEN STORAGE IN THE FASTING RAT.

Treatment of rats	Amount injected	Number of rats in group	Blood sugar mgm./100 c.c.	Liver weight gm./100 gm. body weight	Liver glycogen gm./100 gm.	Muscle glycogen gm./100 gm.
Killed initially	—	30	97	2·86	0·85	0·31
Injected and fasted 30 hours	Nut oil only	35	95	2·87	0·57	0·31
" " " " " "	0·10 mgm.	20	93	2·94	1·04	0·32
" " " " "	1·00 mgm.	25	99	3·01	1·96	0·34
" " " " "	10·00 mgm.	20	109	3·98	2·04	0·30

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RESEARCH ITEMS

Early Cult Figures from the Indus Valley

SEALS showing the figure of an unidentified deity found at Mohenjo-daro have been identified tentatively by Sir John Marshall as Śiva-Paśupati, but Saletore regards them as representations of Agni. The latter would weigh in favour of the Aryan hypothesis of Harappa cultural origins in the Indus Valley. Agni has no counterpart in the pre-Aryan cultures known to us. The argument in favour of the identification with Siva rests in part on the character of the trident-like head-dress, which Saletore maintains does not represent Siva's trident. This head-dress is regarded by A. Aiyappan (*J. R. Asiat. Soc. Bengal, Letters*, **5**, 3; 1940) as the key to the understanding of the nature of the religious representation intended by the seals on which the figures appear. Taken as a group, there can be little doubt that the sculptor intended to show two, not three, horns. Agni is shown as three or four horned, and though he is likened to various animals such as bull, steed, winged bird, or goat, nowhere is there any suggestion that he should have a pair of buffalo or bison horns. To the ethnologist the head-dress is full of interest. Its various forms find counterparts in the head-dresses of modern Indian tribes, the Bison-horn Gonds, the Koyas and Savaras of the Eastern Ghats and the Naga tribes of Assam. That of the Kalyo Kengyu warrior of the Naga Hills is almost a modern copy of that of the Mohenjo-daro figures. The meaning of the latter can only be gathered if considered from the ethnological angle, though identity of significance must not be postulated. Nevertheless, it would appear from modern instances that there are rites allocated with fertility and buffalo cults which still exist among many tribes and even Hindu castes in a vestigial and attenuated form but may well have been a living cult when the culture of Mohenjo-daro flourished. The Mohenjo-daro deity does not possess many attributes of the Siva of modern Hinduism, but his most fundamental qualities are suggestively indicated—the horns suggesting the trident and fertility, the phallic aspect and the pose and surroundings of Siva's yogic characteristics.

Studies on Reef Corals

VOL. 2, No. 1, of the Palao Tropical Biological Station, Tokyo, 1940, includes several papers on reef corals dealing with growth, biochemistry and environment. S. Motoda contributes three: "A Study of Growth Rate in the Massive Reef Coral *Goniastrea aspera* Verill", "The Environment and the Life of the Massive Coral, *Goniastrea aspera* Verrill", and "Comparison of the Conditions of Water in the Bay, Lagoon and Open Sea in Palao". K. Hosoi in his work on the biochemistry of the coral has investigated the "Occurrence of Iodine in the Polyp of *Funigia actiniformis* var. *palawensis* Döderlein, the Distribution of Nitrogen in the Protein of the Polyp, and the Amount of Calcium and Carbonate in the Skeleton". N. Abe writes on the growth of the same species and its environment. Interesting observations are made by Motoda on Goniastrea in which he finds that the actual living polyps are eaten by certain fishes. This coral when transplanted to the reef margin was much damaged by being bitten by fishes, although this did not take place in its natural habitat. The author also observed that the reef fishes in the aquarium of the Laboratory frequently pick the living polyps of the reef corals until these lose the soft bodies and are killed. Also he states that it is seen when diving that many small reef fishes are picking upon the surface of the living corals. Although, as other observers have maintained, it may be that the fishes are feeding on the algæ growing on the corals, these new observations appear to show that the fishes do eat the actual polyps. In addition to the studies on corals there is a paper on the "Oligochæta from the East and West Carolines, South Sea Islands" (I) by S. Ohfuchi, and one on the "Luminescence of the Fishes belonging to the Family Leiognathidæ of the Tropical Pacific" by Y. Haneda.

Measurement of Solar Radiation

A PAPER on the measurement of solar radiation for ecological work has recently appeared (Bericht über das Geobotanische Forschungsinstitut Rübel in Zürich für das Jahr 1939. Von E. Rübel und W. Lüdi. Pp. 152. Zürich: Geobotanische Forschungsinstitut Rübel, 1940). It describes a dozen different sorts of commercially produced apparatus (mostly unfamiliar to the reviewer) some intended to measure the total energy of radiation, others particular wave-lengths, and yet others the total energy over a period. The principles and limitations of each apparatus are discussed, and should enable a reader with a definite problem to choose his apparatus. The other papers deal with the changes observed in some quadrats of alpine grassland over a century, the alpine vegetation of Mt. Etna (both treated statistically), and a very brief paper on pollen analysis.

Nomenclature of Fungal Genera

MYCOLOGISTS, as the custodians of nomenclature in one of the most dynamic groups of living organisms, have the duty of critical review of their taxonomic groups, as knowledge about the systematics of their subject increases. A committee of the British Mycological Society has been appointed to perform this work, and the third of its "Nomina Generica Conservanda" has recently been published under the name of E. M. Wakefield, secretary to the Committee (*Trans. Brit. Mycol. Soc.*, **24**, Pts. 3 and 4, 282–293; Dec. 1940). This deals, among other questions, with the nomenclature of Daldinia, Dothidella, Agaricus and Psalliota, Septoria and Ramularia. It is necessary that someone should work through the mass of what would be dreary detail for most workers. The recommendations of the committee are usually trenchant; only in its consideration of Agaricus versus Psalliota has it lost the determination to return from the established Psalliota to the valid Agaricus.

Intergeneric Hybrids of Saccharum

E. K. JANAKI-AMMAL (*J. Gen.*, **41**, 217–254; 1941) has described intergeneric hybrids of Saccharum with species of Narenga, Erianthus, Sorghum, Zea, Bambusa and Imperata. The variety and number of these hybrids together with their morphology and fertility provide astonishing and most valuable information regarding the possibilities of hybridization involving a high polyploid, such as is found in Saccharum. The present paper describes: (1) the cross *S. spontaneum* ($2n = 112$) with *Erianthus ravennæ* ($2n = 20 + f.$). The F_1 has 66 chromosomes and is fertile and gives rise to diploids, triploids and tetraploids. Segregation of Erianthus characters occurs among the diploids. The chromosomes of *S. spontaneum* form bivalents, by autosyndesis in the F_1, and may form trivalents with some of the chromosomes of Erianthus. The sugar content of the diploid F_1 is lower than in *S. spontaneum*. (2) The cane POJ2725 arose from continued crosses of *S. spontaneum* with *S. officinarum* ($2n = 80$) and has $2n = 106$. When this plant was crossed with *Imperata cylindrica*, thirty-five seedlings with fairly high sugar content were obtained. These were (*a*) vegetative seedlings and resembled the maternal parent, (*b*) selfed or parthenogenetic seedlings with 108–112 chromosomes, (*c*) triploid self seedlings ($2n = 156$), and (*d*) true hybrids ($2n = 120$–134). Seedlings from this last category segregate for Imperata characters. (3) In crosses of *S. officinarum* with *Zea Mays* ($2n = 20 + 1B$), one hybrid which survived had 52 chromosomes and remained dwarf and has not flowered. Novel characters, not present in the parents, are seen in the hybrid.

South African Geology

THE country around Potchefstroom and Klerksdorp is one of the most interesting districts of the Transvaal, including, as it does, all the principal geological formations from the Witwatersrand to the Coal Measures of the Karroo, with the exception of the Waterberg system. The area has been described in detail by L. T. Nel and others in the "Explanation of Sheet No. 61", recently published by the Geological Survey of South Africa. The extraordinarily thick Witwatersrand system was accumulated above a denuded and subsiding surface of the Older Granite, occasional pebbles of which have been found in the lower Witwatersrand grits. A second unconformity comes between the Witwatersrand and the Ventersdorp lavas and is particularly marked in the Klerksdorp area. A third break is found at the base of the Transvaal system, which was deposited on a comparatively flat surface like that of a peneplain. After the close of this period the older rocks were subjected to regional folding and erosion. Long afterwards the Coal Measures of the Karroo system were deposited. Most of these flat-lying beds have been since removed by denudation, and the underlying structure is seen to be a major syncline of Transvaal sediments with older formations arched up on both sides. The axis curves round the Vredefort dome, part of which appears in the south-eastern corner of the area mapped. As the Older Granite which occupies the central portion of the dome is older than the Witwatersrand system, it must have been raised as a solid plug through a vertical distance of thousands of feet. The origin of this unique structure, with its associated overturning of the surrounding rocks and the production of pseudotachylyte, has aroused wide discussion. Dr. Nel, however, is obliged to admit that a complete solution of the tectonic problem cannot yet be claimed. The memoir contains an important review of the magnetic anomalies in the Witwatersrand system, petrological details of the many igneous rocks of the area, and a full account of the economic products, with special reference to gold and water supplies.

Heavy Oxygen

THE fact that oxygen in air has a somewhat higher atomic weight than that in water was discovered by Dole in 1935, and the difference has since been measured by several observers. There is still some uncertainty attached to the results owing to (1) the still imperfectly known degree to which different natural waters differ in density, (2) the possibility of variation of the same source of water at different times, (3) the possibility of different isotopic separations during the purifications. The rapid and complete exchange of oxygen in many inorganic salts with the solvent water suggests that the Dole effect could be measured by this method, and some experiments with sodium dichromate have been reported by O. R. Alexander and N. F. Hall (*J. Amer. Chem. Soc.*, **62**, 3462; 1940). Exchange experiments were made with water synthesized from atmospheric oxygen and Lake Mendota water as standard. The results showed that the excess density due to air oxygen is $7{\cdot}65 \pm 0{\cdot}2\ \gamma d$ with Madison city water regarded as normal and $7{\cdot}1 \pm 0{\cdot}2\ \gamma d$ with Lake Mendota water regarded as normal. The oxygen of the dichromate was somewhat heavier than that of the lake water and much lighter than that of the air water. These experiments thus substantiate the Dole effect.

Reactions of Atoms and Free Radicals in Solution

IT appears that substitution and displacement reactions in organic chemistry fall into two groups in which the reaction proceeds by (A) an ionic or polar mechanism and (B) atomic or free radical. The photochemical (peroxide catalysed) chlorination of a hydrocarbon is a familiar example of a B-type reaction with two possible mechanisms with the chlorine atoms produced in the primary process:

(B_1)	(B_2)
$Cl\cdot + RH = RCl + H\cdot$	$Cl\cdot + RH = R\cdot + HCl$
$H\cdot + Cl_2 = HCl + Cl\cdot$	$R\cdot + Cl_2 = RCl + Cl\cdot$

The substitution of chlorine for hydrogen on the asymmetric carbon atom of an optically active compound by process B_1 would result in Walden inversion with retention of optical activity, whilst the reaction according to process B_2 would yield an optically inactive *dl* product if a free radical with an appreciable half-life period is formed. H. C. Brown, M. S. Kharasch and T. H. Chao (*J. Amer. Chem. Soc.*, **62**, 3435; 1940) have investigated the photochemical chlorination of primary active amyl chloride from this point of view. Six possible isomers result from the introduction of a second chlorination, and it was necessary to isolate the 1,2-dichloro derivative and examine it for optical activity. This could be done by careful fractional distillation, and the product was found to be optically inactive, thus indicating that substitution occurred by process B_2. The other products of the reaction were also investigated, and the two isomers not previously reported were isolated.

PARALYSIS PRODUCED IN WHITE RATS BY A RACHITOGENIC DIET

By DR. H. A. SHAPIRO,

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DURING the course of rachitogenic experiments with white rats it was noticed that if the rats were kept for prolonged periods on Steenbock's No. 2965 diet, a progressive paralysis of the hind limbs developed.

The diet consisted of the following:

Whole yellow maize (finely ground)	76 per cent
'Energen' gluten	20 ,,
Calcium carbonate	3 ,,
Sodium chloride	1 ,,

Young rats of either sex weighing 40–60 gm. when placed on this diet developed severe rickets in three weeks. This was obvious by swelling of the wrists

a *b* *c*

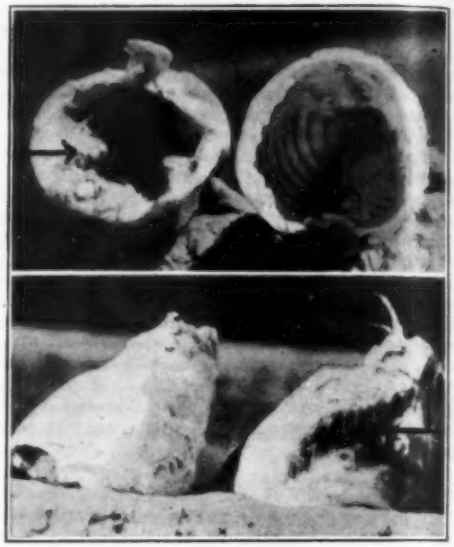
Fig. 1.

a, NORMAL BONE (RADIUS AND ULNA); *b*, PARTIAL HEALING; *c*, SEVERE RICKETS.

and the knees, and was further demonstrated (*a*) in sections of the distal halves of the radius and the ulna stained by the usual silver nitrate method, (*b*) by X-ray studies of the bones.

Fig. 2.

EXTENSOR WEAKNESS OF RIGHT FOOT.



INFERIOR (ABOVE) AND LATERAL (BELOW) ASPECTS OF CHEST. THE RICKETY CHEST, SHOWING COLLAPSE OF RIBS, IS ON THE LEFT ABOVE, AND ON RIGHT BELOW.

When the animals were kept for considerably longer on this diet the rickets became much worse (Fig. 1*c*) and after 6–9 weeks the earliest signs of weakness of the hind limbs developed. This consisted of a widening of the base, especially well marked in some of the animals at rest, together with a well-defined foot-drop (Fig. 2) in either or both feet due to weakness of the extensor ('antigravity') muscles and an inco-ordination of the gait. The weakness of the hind legs spread progressively until after 7-10 days the animal was unable to stand on all fours. It then progressed by pulling its hindquarters along with the aid of its forelimbs, which showed no signs of weakness in spite of the severe degree of rickets.

With the full development of the paralysis other signs of a cord lesion appeared, namely, urinary incontinence and a persistent priapism.

The paralysis was not flaccid although there was considerable wasting of the thigh muscles, especially of the extensors. Definite tone was maintained in the flexors (hamstrings) and in the tail. Such animals showed maximal rachitic signs; for example, the development of a marked degree of 'pigeon chest' due to the falling in of the ribs (Figs. 3 and 4). In all, a total of eight animals was placed on this diet in the course of five months. All eight animals developed this paralysis.

Autopsy of three of the animals failed to reveal any macroscopic hæmorrhages in the nervous system. The marked atrophy of all the thigh muscles, especially of the extensors, was confirmed.

There was a superabundance of carotene in the diet (yellow maize) and there was no evidence in the eyes or the teeth of any vitamin A deficiency. The colour of the teeth was, if anything, better than that of the normal control animals. This point is of importance, since Irving and Richards[1] have reported that degenerative changes are observed in the nervous system of rats on a vitamin A deficient diet. In their experiments, however, the chief changes were seen in the medulla.

At no stage in the development of the paralysis was there any evidence of a peripheral neuritis such as might be attributable to an aneurin (vitamin B_1) deficiency, namely, pain and tenderness of the affected limbs when these were palpated. Moreover, clinically the syndrome of progressive paralysis did not resemble the paralysis produced by vitamin B_4 deficiency in rats[2,3]. B_4 deficiency in rats results in the adoption of a hunched position 'walking high' on the hind-legs with a progressive loss of co-ordination[3].

It appears unlikely that vitamin C can be involved in the production of this syndrome.

α-tocopherol, whether given by mouth or by injection in the form of the acetate, at the stage when foot-drop was noticed, was unable to arrest the steady progression of the weakness.

The possibility still exists that some other component of the E complex may be involved. In view of the fact that whole maize was used it appears unlikely that the diet could have been E deficient, in spite of the fact that clinically the syndrome fairly strongly resembles the picture of vitamin E deficiency. In any event the paralysis is unlikely to be due to an α-tocopherol deficiency.

The possibility remains that the lesions may be due to marked vitamin D deficiency in one of two ways:

(1) Vitamin D may be necessary for the proper nutrition of the nervous system.

(2) Since the paralysis so far has been observed only in severely rachitic rats, the lesion may be secondary to a mechanical complication as a result of the rachitic process having affected the vertebræ, especially in the lumbar region. I am indebted to Dr. N. Sapeika for this suggestion.

It is of interest to note that Greenberg, Boelter and Knopf[4] reported observations on rats on a low calcium diet which accorded with the description of neurological lesions in rachitic rats described by Boer, Arons and van der Ryst[5]. Van der Ryst and Arons[6] also used the Steenbock No. 2965 diet, and they described paralysis and hæmorrhages in the nervous system in 75 per cent of rachitic rats on this diet. They did not conclude, however, that the symptoms were due to lack of vitamin D.

The simplicity and the purity of the diet used in the experiments recorded in this note render it unlikely that the syndrome observed is due to a poison or toxin.

It remains possible that the symptoms resulted from protracted vitamin D deficiency, or that some other vitamin is necessary for the proper nutrition of the nervous system. Although it seems most unlikely that the vitamin E complex is involved here, it should be noted how closely the paralysis described in these experiments resembles the paralysis seen in the hind limbs in vitamin E deficiency. On this rachitogenic diet the forelimbs were never affected. This is unlike vitamin E deficiency paralysis.

Further studies on the histology of the nervous system and the affected muscles, as well as of the prophylactic role of vitamin D and certain other vitamins, are in progress.

I wish to thank Prof. W. F. Rhodes for his interest in this investigation. The photographs are 'stills' taken from a moving picture record made by Mr. L. Lewis.

[1] Irving, J. T., and Richards, M. B., *J. Physiol.*, **94**, 307 (1938).
[2] Reader, V., *Biochem. J.*, **24**, 1827 (1930).
[3] Kline, O. L., Elvehjem, C. A., and Hart, E. B., *Biochem. J.*, **30**, 780 (1936).
[4] Greenberg, D. M., Boelter, M. D. D., and Knopf, B. W., *Science*, **89**, 18 (1939).
[5] Boer, J., Arons, P., and van der Ryst, M. P. J., *Arch. Neerl. Physiol.*, **22**, 594 (1937).
[6] Van der Ryst, M. P. J., and Arons, P., *Arch. Neerl. Physiol.*, **23**, 592 (1938).

FORESTRY IN BALUCHISTAN

THOSE who have visited Baluchistan, even if such a visit was confined to Quetta only, will know that most of the country, the total area of which is 126,000 square miles, of which 53,000 square miles are under British administration, is mountainous with broad upland valleys and that there is a striking lack of trees and a general absence of vegetation. Barren, sunburnt, rugged hills scored by rocky precipitous gorges, the slopes with scattered dots representing juniper or olive stunted trees, alternate with bare stony plains. Parts of this country, as is the case with the adjacent Seistan and Iran, are fertile enough once water can be brought to them. The rainfall is low, 5–15 in. (the latter in the highlands), but is not so deficient that it could not support, and did once support, a better type of vegetation. Examples are noted of forests having disappeared within the last fifty years, notably around Quetta and near the railway, around Fort Sandeman and Loralai, near Tomagh State Forest, and so forth. It is held that desert conditions are advancing from the west and that these conditions are due to the improvident and unchecked habits and actions of the population—felling, lopping, bark stripping, and excessive and continuous goat browsing, in which the nomads are probably the worst offenders. Erosion is very severe, and one stream which has been under observation is reported as carrying away as much as 450 tons of soil in an hour. Many of these facts have been known for the last three or four decades, but they have never received really serious attention by the administration, and such forest service as there has been has been negligible and of inferior status.

Attention has been directed to the present position of affairs in a "Note on a Tour of Inspection of Baluchistan" by S. H. Howard, acting inspector

general of forests (Government of India Press, Simla, 1940), and the report comes none too soon if the remnant of vegetation and the forests in the highlands are to be saved from extermination.

It is a curious reflection on British administration that in so many parts of the world at the present day the similar problem of the man-made desert being brought about by the unchecked acts of the people upsetting to the ordinary laws of Nature is presenting itself to the British administrator.

Juniper (*Juniperus macropoda*, Boiss.) is one of the chief species of the country, and there are remnants of an old forest at Ziarat. The wood of this tree could, says Mr. Howard, be used for pencils, slate frames, picture frames, and so forth, for which a sale might be developed, or a local factory might pay. This presupposes that a greater protection of the forests is introduced by Government and that the Government forest area should be raised from 0.6 per cent of the country (its present extent) to something nearer 20 per cent. Other tree species are olive (*Olea ferruginea*) and khanjak (*Pistacia Khinjuk*). Of these, rough statistics appear to show that a juniper takes 40–180 years to grow one foot in girth (a 6-ft. tree is 250–1000 years old), an olive coppice shoot about 35 years to grow one foot girth, and a khanjak about 25 years. The principal minor product is Ephedra, but Artemisia, Hyoscyamus, Datura, juniper berries and perhaps Pyrethrum are other possibilities. In the highlands one of the chief species is the beautiful chilghoza or silver-barked pine (*Pinus Gerardiana*).

Of course, in so dry a country fuel becomes an important problem. There appears to have been a great development in its supply during the last few years with a corresponding high level of expedition in extraction. This scheme would be disquieting in so barren a country, and Mr. Howard makes recommendations which would certainly appear to be required, that a chief forest officer from the Imperial Forest Service should be appointed, and that the forestry question in Baluchistan should be treated as a question which has become of serious importance if the conditions of life of the population are to be improved instead of the country being permitted to fall into a state of greater desiccation and denudation.

FORTHCOMING EVENTS

[*Meeting marked with an asterisk is open to the public.*]

Saturday, March 22

ROYAL PHOTOGRAPHIC SOCIETY (Scientific and Technical Group) (at 16 Princes Gate, London, S.W.7), at 3 p.m.—I. Annual General Meeting; II. "Airscrew", a 16 mm. Sound Film, illustrating Design, Manufacture, Precision, etc.; III. A Demonstration of some Captured German Cameras by a Service Officer.

Tuesday, March 25

ROYAL INSTITUTION (at 21 Albemarle Street, London, W.1), at 2.30 p.m.—Sir James Jeans, F.R.S.: "The Physical Condition of the Planets".*

ROYAL ANTHROPOLOGICAL INSTITUTE (at 21 Bedford Square, London, W.C.1), at 3 p.m.—Miss B. Blackwood: "Some Arts and Industries of New Guinea and New Britain" (Films).

Wednesday, March 26

ROYAL SOCIETY OF ARTS (at John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—Sir Richard Gregory, Bart., F.R.S.: "Discovery and Invention" (Aldred Lecture).

Thursday, March 27

BRITISH PSYCHOLOGICAL SOCIETY (Industrial Section) (at 55 Russell Square, London, W.C.1), at 1.20 p.m.—Dr. Marie Jahoda: "Some Remarks on Incentives to Work".

Friday, March 28

ASSOCIATION OF APPLIED BIOLOGISTS and SOCIETY FOR EXPERIMENTAL BIOLOGY (Joint Meeting at the London School of Hygiene and Tropical Medicine, Keppel Street, London, W.C.1), at 12 noon.—Discussion on "The Relationship between Pure and Applied Biology". 12.5 p.m.—Prof. P. A. Buxton: Opening Address. 12.35 p.m.—Prof. W. B. Brierley will speak from the Botanical side. 2.15 p.m.—Dr. V. B. Wigglesworth, F.R.S.: "Malaria and War". 3 p.m.—Dr. M. A. H. Tincker: "Aspects of the Application of Growth Substances to Practice".

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at the Mining Institute, Newcastle-upon-Tyne), at 6 p.m.—Mr. W. T. Bottomley: "The Economics of the Design of Condenser Plant and Cooling Water Systems, applicable to Power Stations".

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

PRINCIPAL OF THE LEEDS COLLEGE OF TECHNOLOGY—The Director of Education, Education Department, Calverley Street, Leeds 1 (March 29).

TEACHER OF SPEECH TRAINING in the Aberdeen Education Committee's Schools—The Director of Education, Education Offices, Municipal Buildings, Castle Street, Aberdeen (March 29).

LECTURER IN MECHANICAL ENGINEERING SUBJECTS in the Schools of Technology, Art, and Commerce, Oxford—The Chief Education Officer, City Education Office, 77 George Street, Oxford (April 2).

HEAD OF THE MECHANICAL AND CIVIL ENGINEERING DEPARTMENT of Sunderland Technical College—The Secretary, Technical College, Sunderland (April 5).

ASSISTANT PROFESSOR IN THE DEPARTMENT OF GLASS TECHNOLOGY—The Registrar, The University, Sheffield (April 18).

UNIVERSITY LIBRARIAN—The Registrar, The University, Sheffield (April 18).

PROFESSOR OF ZOOLOGY at Bedford College for Women—The Academic Registrar, Royal Holloway College (University of London), Engefield Green, Surrey (April 21).

ASSISTANT LECTURER IN PHYSIOLOGY—The Secretary, The University, Edmund Street, Birmingham 3 (April 25).

RADIUM OFFICER—The Secretary, Radium Institute, 1 Myrtle Street, Liverpool.

ASSISTANT ENGINEER FOR THE DRAINAGE AND IRRIGATION DEPARTMENT, Malaya—The Crown Agents for the Colonies, 4 Millbank, London, S.W.1 (quoting M19316).

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Carnegie Trust for the Universities of Scotland. Thirty-ninth Annual Report (for the Year 1939–40) submitted by the Executive Committee to the Trustees on 10th February 1941. Pp. iv+86. (Edinburgh: Carnegie Trust for the Universities of Scotland.) [122

Other Countries

Bericht über des Geobotanische Forschungsinstitut Rübel in Zürich für das Jahr 1939. Von E. Rübel und W. Lüdi. Pp. 152. (Zürich: Geobotanische Forschungsinstitut Rübel.) [102

Canada: Department of Mines and Resources, Mines and Geology Branch: Bureau of Mines. Stabilized Roads. By R. H. Picher. (No. 800.) Pp. v+41 (3 plates). (Ottawa: King's Printer.) 25 cents. [103